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BEING PART OF

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AT THE

BEGINNING OF THE FIRST SESSION OF THE FIFTY-FOURTH CONGRESS.

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REPORT OF MAJ. T. H. HANDBURY, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Johns River, Fla., 1529; Upper St. Johns River, Fla., 1534; Volusia Bar, Fla., 1536; Ocklawaha River, Fla., 1537; St. Augustine Harbor, Fla., 1539; Indian River, Fla., 1541; northwest entrance, Key West Harbor, Fla., 1546; Caloosahatchee River, Fla., 1549; Charlotte Harbor and Pease Creek, Fla., 1551; Sarasota Bay, Fla., 1553; Manatee River, Fla., 1555; Withlacoochee River, Fla., 1556; Suwanee River, Fla., 1558; removing sunken vessels or craft obstructing or endangering navigation, 1560.
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APPENDIX O.

REPORT OF MAJ. F. A. MAHAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Apalachicola Bay, Fla., 1611; Apalachicola River, the Cut-off, and Lower Chipola River, Fla., 1615; Flint River, Ga., 1617; Chattahoochee River, Ga. and Ala., 1619; Choctawhatchee River, Fla. and Ala., 1626; harbor at Pensacola, Fla., 1629; Escambia and Conecuh rivers, Fla. and Ala., 1661; Alabama River, Ala., 1663; Coosa River, Ga. and Ala., 1670; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., 1679.
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REPORT OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mobile Harbor, Ala., 1683; Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 1691; Warrior and Tombigbee rivers, Ala. and Miss., 1692; Noxubee River, Miss., 1699; Pascagoula River, Miss., 1700; Chickasahay River, Miss., 1703; Leaf River, Miss., 1704; harbor at Biloxi Bay, Miss., 1705; Pearl River below Jackson, Miss., 1706; Pearl River between Carthage and Jackson, Miss., 1708; Pearl River between Edinburg and Carthage, Miss., 1710; Bogue Chitto, La., 1711; removing sunken vessels or craft obstructing or endangering navigation, 1712.
EXAMINATIONS AND SURVEY.—Bar in Horn Island Pass, Miss., 1714; Noxubee River, Miss., from Macon to mouth of Hashuqua Creek, 1715; channel between Mobile Bay and Mississippi Sound, 1716.

PART III.

APPENDIX Q.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

INSPECTION of the improvement of the South Pass of the Mississippi River, 1725.

APPENDIX R.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chefuncte River and Bogue Falia, La., 1742; Tickfaw River and its tributaries, La., 1744; Amite River and Bayou Manchac, La., 1747; Bayou Lafourche, La., 1750; Bayou Terrebonne, La., 1753; Bayou Plaquemine, Grand River, and Pigeon bayous, La., 1754; Bayou Courtableau, La., 1760; Bayou Teche, La., 1763; channel, bay, and passes of Bayou Vermilion, La., 1766; Mermentau River and tributaries, La., 1768; mouth and passes of Calcasieu River, La., 1770; harbor at Sabine Pass, Tex., 1774; Sabine River, Tex., 1778; Neches River, Tex., 1781; removing sunken vessels or craft obstructing or endangering navigation, 1782.

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REPORT OF CAPT. JOHN MILLIS, CORPS OF ENGINEERS.

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REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Entrance to Galveston Harbor, Tex., 1797; ship channel in Galveston Bay, Tex., 1806; channel in West Galveston Bay, Tex., 1809; Trinity River, Tex., 1813; Cedar Bayou, Tex., 1815; Buffalo Bayou, Tex., 1816; harbor at Brazos Santiago, Tex., 1819.

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REPORT OF LIEUT. WILLIAM L. SIBERT, CORPS OF ENGINEERS.

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REPORT OF MAJ. CHARLES J. ALLEN, CORPS OF ENGINEERS.

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ANNUAL REPORT OF THE MISSISSIPPI RIVER COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

ARMY BUILDING,
New York City, July 1, 1895.

SIR: The Mississippi River Commission beg leave to submit herewith their annual report for the fiscal year ending June 30, 1895.

APPROPRIATIONS AND ALLOTMENTS.

The appropriations and allotments made in 1894 were as follows:

River and harbor act of August 17, 1894, specific appropriations.

New Madrid, Mo	$20,000
Memphis, Tenn	50,000
Greenville, Miss	80,000
Natchez and Vidalia, Miss. and La	80,000
Atchafalaya and Red rivers, Louisiana	70,000
New Orleans, La	110,000
From appropriation for St. Francis River, Arkansas (to be expended by Mississippi River Commission at Walnut Bend)	75,000

Sundry civil act of August 18, 1894.

Mississippi River Commission	41,000
Surveys, gauges, and observations	97,100
Channel works (construction)	662,400
Plant	212,500
Dredges and dredging	150,000
Levees	1,502,000
Total	2,665,000

The appropriation of 1895 has been allotted as follows:

Sundry civil act of March 2, 1895.

Mississippi River Commission	$15,000
Surveys, gauges, and observations	139,780
Channel works (construction)	497,000
Plant	60,000
Dredges and dredging	350,000
Levees	1,600,220
Unallotted	3,000
Total	2,665,000

SURVEYS, GAUGES, AND OBSERVATIONS.

Secondary triangulation.—During the past season this work has been extended from Prairie du Chien, Wis., to Trempealeau, Wis., a distance of 78 miles, and stone line bench marks have been placed over the same section of river.

Topography and hydrography.—The regular work of the Mississippi River survey has been carried northward from Keithsburg, Ill., to Davenport, Iowa, a distance of 55 miles. On the lower river a low-water survey between banks was made during the fall season of 1894 from the mouth of the Arkansas River to Vicksburg, Miss., a distance of 200 miles. The object of this survey was by comparison with earlier surveys to afford means of determining changes in river section due to the extensive levee construction of recent years.

Transalluvial levels.—Cross profiles of the river valley above Cairo have been in progress. Nineteen have been run at distances apart of about 20 miles.

Gauges.—The records of 31 gauges on the Mississippi, and of 25 on the tributaries, have been received, platted, and tabulated. The record for 1894 has been published. All the gauges maintained by the Commission have been inspected, repaired, and corrected when necessary.

Maps.—Reduction and platting of notes of recent surveys has been in progress during the year, and detail charts, scale 1 : 10000 from La Grange, Mo., to Keithsburg, Ill., as also Nos. 81 to 83 from Head of Passes northward have been completed. Nos. 70 to 80, inclusive, from Donaldsonville, La., southward are partially completed.

Of the inch-mile sheets, Nos. 114 to 118, from Quincy, Ill., to Keithsburg, Ill., and No. 32, vicinity of the Passes, have been completed.

The alluvial map of the valley above Cairo has been begun and completed to the mouth of the Illinois, and partially completed to Oquawka, Ill., 440 miles above Cairo.

There have been published of the 1 : 20,000 detail charts Nos. 132 to 136, which includes the Des Moines Rapids; also chart No. 83. Eight more of these charts are in the hands of the printer.

Of the inch-mile series, sheet No. 114 has been published, and Nos. 115 to 118 are being printed.

Recent discharge observations made by the district officers have been recomputed and published.

During the current season it is proposed to continue the survey of the Upper Mississippi and to extend the low-water survey of the Lower Mississippi from Vicksburg to Donaldsonville.

For details see report of Capt. George A. Zinn, Corps of Engineers, U. S. A., secretary of the Commission. (Appendix 4.)

CONSTRUCTION.

FIRST DISTRICT (CAIRO TO FOOT OF ISLAND NO. 40, 220 MILES).

District officer, Capt. S. W. Roessler, Corps of Engineers, U. S. A., to January 7, 1895; since that date, Capt. G. D. Fitch, Corps of Engineers, U. S. A.

Columbus, Ky., 21 miles below Cairo.—The front of the town is protected from caving by five spur dikes of brush and stone, built in 1889 and 1890. They cover 2,200 feet of bank. During the past season slight caving has occurred between the spurs, but it has not been serious enough to require attention.

Hickman, Ky., 36 miles below Cairo.—Under the provisions of the last river and harbor act, which required the expenditure at this place of a balance of a former appropriation, the revetment in front of Hickman was extended downstream 630 feet, and the work of previous years was repaired and strengthened. No further work is thought to be necessary.

New Madrid, Mo., 71 miles below Cairo.—The protection at this locality consists of a brush mattress revetment extending downstream from the mouth of Bayou St. John. Of this revetment 900 feet had been constructed in 1893 and 1894, and 725 feet was added during the past season. This work exhausted the special appropriation of $20,000. Further extension of the work will be needed to protect the whole front of the town.

Plum Point Reach, 147 to 186 miles below Cairo.—Work on this reach extends over 20 miles of river, from Canadian Reach to the foot of Bullerton Towhead.

During the past season the revetment of Ashport Bend was completed by the addition of 1,380 feet to the 15,000 feet already constructed.

At Bullerton Towhead the new revetment in course of construction at date of last report was completed, 5,349 linear feet of bank was protected in addition to the work of 1893, 4,080 feet in length.

The revetment constructed some years since at Daniels Point has been subjected to very severe strain and now requires extensive repairs, especially to the bank above low water. Provision has been made for carrying on this work during the present season, and also for extending the revetment upstream a distance of 5,000 feet.

The revetment heretofore constructed in Fletchers Bend was partly continuous and partly detached. This latter portion, which was experimental, has failed by the excessive caving between the detached mattresses. A series of short stone spurs have been ordered with a view to checking this action.

To prevent enlargement of the channels leading into Osceola Chute, a revetment 3,750 feet long will be constructed, during the present season, across the head of these channels.

The dam heretofore built across the Gold Dust Chute settled somewhat during the high water of 1894, and two breaks occurred as well. These were repaired and the dam was raised nearly to its original level. It will probably require watching and more or less repairs for several years.

Levees.—These all lie in the Lower St. Francis levee district. Four miles of levee were built from near Barfields Landing northward to meet a line constructed by the State levee board from the Missouri-Arkansas line south. The percentage retained for high water protection was used in assisting to close the Tyler gap near the State line.

Finally, the last allotment for this levee district is being expended in carrying the main line of levee from Stewarts Landing, Missouri, southward. When this work is completed there will be a continuous line from Point Pleasant, Mo., to Deans Island in Arkansas, or nearly down to Memphis. For details see report of Captain Fitch. (Appendix 5.)

SECOND DISTRICT (FOOT OF ISLAND NO. 40 TO MOUTH OF WHITE RIVER, 180 MILES).

District officer same as for first district.

Hopefield Bend, 225 miles below Cairo.—Some 3 miles of the shore of this bend, from Mound City, Ark., to Hopefield Point opposite Memphis, has been protected by revetment. The upper portion has been covered by a sand bar, but the lower 2 miles is subjected to a very heavy strain, and has required repairs every year. During the last season this work was confined mainly to paving the bank near low water with stone.

Memphis Harbor, 230 miles below Cairo.—The upper portion of the river front of Memphis has been revetted for several years, but in the lower portion of the city there still remained an unprotected stretch of

3,800 feet between the Citizens dikes and the Bridge Company's revetment. During the past season 1,260 feet of this gap was protected by brush mattresses 300 feet wide.

Wolf River.—The special appropriation for work on this stream has not yet been expended. It is proposed to devote it to the removal of snags and other obstructions, and to dredging from the mouth of the stream up as far as the available funds will allow.

Nouconnah Rock.—This rock lies in the channel of the chute of President's Island, some 3 miles below Memphis, and is much in the way of steamers. It was partly blasted out in 1893, but will require still further work for its entire removal.

Helena, 306 miles below Cairo.—Three thousand feet of the river bank in front of the lower end of the town is protected by a combination of spur dikes and mattress revetment. No further work is recommended at present.

LEVEES.

In the Upper Yazoo levee districts 20 miles of levee has been raised and enlarged from Commerce, Miss., south. To the north of Commerce 15 miles of levee is being raised and enlarged, and work is in progress on the Moon Lake levee, or Delta loop.

On the right bank a levee 6 miles long has been built under special appropriation near Walnut Bend, Ark., to prevent a threatened cut-off into St. Francis River. This levee will ultimately form part of the main line.

In the upper White River levee district, the main levee line has been extended four miles from Modoc Landing south. The allotment for the coming year will be used to extend this levee some 2 miles farther, and to build a cross line at the head of the system near Helena, 0.7 mile long.

In the lower White River levee district, the Big Henrico levee has been enlarged and the main line extended north about 3 miles. During the coming year the Henrico and Laconia levees will be enlarged and the main line extended northward as far as possible.

DREDGES.

The experimental dredge constructed by the Commission was worked during the last season, partly under the direction of the committee on dredges of the Commission, and partly under the officer in charge of the first and second districts. After some preliminary trials near St. Louis, the boat worked on Cherokee Bar in the Lower Mississippi, and at Devil's Island above Cairo. Full details of these experiments are given in the appendices. The Commission was sufficiently well satisfied to order another dredge of considerably greater power than the first, and which it is hoped to have ready for work this season. The experimental dredge is being remodeled to some extent and prepared for further work.

The routine work of local surveys, maintenance of gauges, and various observations were kept up during the year.

For details of operations in second district see report of Captain Fitch. (Appendix 5.)

THIRD DISTRICT (MOUTH OF WHITE RIVER TO WARRENTON, MISS., 220 MILES).

District officer, Capt. C. McD. Townsend, Corps of Engineers, U. S. A.

Lake Bolivar Front, 417 miles below Cairo.—The revetment along this front, 4,250 feet in length, was built in 1889 for the purpose of stopping a severe caving of the bank which threatened the great levee across

the head of Lake Bolivar. It has since been repaired and extended from time to time, but has required no attention during the past season. The object sought in its construction has been attained.

Ashbrook Neck, 446 miles below Cairo.—Eight thousand nine hundred feet of revetment covering the upper side of this narrow neck had been constructed prior to the date of the last annual report. Its object was to prevent a cut-off through the neck, which seemed imminent, and which, if it ever occurs, would probably involve similar cut-offs at other of the narrow necks which form such a striking feature of this portion of the river. During the past season the revetment was extended upstream 1,275 feet, and heavier mats were used than heretofore. Their width was 280 feet. In addition to this work, a pocket mat was sunk in the eddy which has formed at the foot of the revetment, and advantage was taken of the very low stage of water to extend down the stone paving of the upper bank.

Greenville Harbor, 478 miles below Cairo.—The front of the town was originally protected by a series of brush spurs. Extensive caving in the bend above destroyed a number of these spurs and threatened the entire system, as well as the town itself, with destruction. To meet this danger the protection of the caving bank of the bend was deemed necessary, and has been carried on from year to year as funds have been appropriated for the purpose. The last high water destroyed another of the spurs and caused so much damage as to require the partial renewal of 2,100 feet of revetment. This work was executed during the past season. With the balance of the appropriation the revetment was extended upstream 1,020 feet, and the stone paving was repaired and carried down to the low-water line.

Lake Providence Reach, 517 to 552 miles below Cairo.—Work on this reach has been limited of late years. At Louisiana Bend, at the head of the reach, slight repairs were made during the season to the revetment constructed in former years.

A formidable caving having developed immediately above the town of Lake Providence, which threatened the town and the levee across the head of the lake, it was determined to revet this caving bank in the usual manner. During the past season 4,780 feet of revetment was constructed. The lower 1,780 feet was 280 feet wide and of construction similar to the style heretofore in use in this district; the upper 3,000 feet was 300 feet wide, and built of brush fascines, a style of construction which had given great satisfaction in the first district. This work will be continued during the present season.

Delta Point, 599 miles below Cairo.—This point is protected by revetment constructed at various times between 1878 and 1884. The object has been to prevent its further recession downstream, which would involve a corresponding increase in the distance from the harbor proper of Vicksburg to the channel of the Mississippi. The holding of this point has been considered essential to any scheme for the improvement of this locality, and the revetment has been from time to time repaired as necessity required. No work was needed during the past season.

LEVEES.

The third district embraces the Lower Yazoo and the Upper and Middle Tensas levee districts. The former extends from the Bolivar-Coahoma county line in Mississippi, and has a line of levees 190 miles long. The two Tensas districts extend from the Arkansas River to a point opposite Warrenton, Miss.

To protect the head of the Tensas system a levee has been run back from the Mississippi, near Arkansas City, to high ground at Amos

Bayou. As this line was flanked by recent floods, further work was needed, and the Commission undertook to rebuild the lower end of the old levee system on the south bank of the Arkansas River, near Red Fork, Ark. Four miles of this levee were built during the past season, and an extension of 9 miles to Lake Jefferson is contemplated for this season. The Amos Bayou levee was also extended 6 miles by the local authorities. This work, in connection with that in progress on the White River front, will, it is hoped, be sufficient for the purpose intended, though this question can only be definitely settled by actual experience.

In the other portions of the upper Tensas levee district, in the lower Tensas, and the lower Yazoo much work was done during the year in repairing and reconstructing existing levees.

The total yardage was 4,226,884 cubic yards, distributed as follows: Lower Yazoo, 1,326,265 cubic yards; upper Tensas, 2,174,629 cubic yards; middle Tensas, 726,000 cubic yards.

Local surveys, low-water discharge measurements, and similar routine work was kept up during the year. For details see report of Captain Townsend. (Appendix 6.)

FOURTH DISTRICT (WARRENTON, MISS., TO HEAD OF PASSES, 484 MILES).

Officers in charge, Capt. John Millis, Corps of Engineers, U. S. A., to October 31, 1894; Maj. James B. Quinn, to November 23, 1894; Capt. George McC. Derby, to date.

Natchez., Miss., and Vidalia, La., harbors, 700 miles below Cairo.—The object of work at this point is the prevention of a cut-off across Cow-Pen Neck, which threatens the destruction of the harbors before mentioned. The approved project contemplates 16,000 feet of revetment in Giles Bend on the north side of the neck and the construction of a spur levee along the axis of the neck to prevent a flow across it at high stages of the river. The total estimate is $541,000. The amount first appropriated, $80,000, not being deemed sufficient to commence so extensive a work as the revetment contemplated, it was decided to build the spur levee first. Various delays occurred in getting the right of way, and it finally became necessary to procure the condemnation of the land required. These formalities were not completed until September 15, 1894, and since then the levee has been built. Its length is 19,500 feet and its cost was $36,500. Plant and stone needed for the revetment are being procured, and work will be begun this season.

Rectification of Red and Atchafalaya rivers, 764 miles below Cairo.—Operations at this locality during the past season were mainly devoted to keeping open the channel from the Mississippi to the Red River during the low-water season. Some repairs were needed by the sills in the Atchafalaya and by the Red River dam. These were executed. The new suction dredge built by the Commission began work in Old River on June 5, and on July 28 a bucket dredge was also assigned to the same duty. Both boats worked until January 4, when the rising river enabled operations to be suspended. The estimated work of the suction dredge during the season was 265,000 and of the bucket dredge 50,000 cubic yards. The work of these dredges, aided by the unusually favorable conditions attendant on the absence of the ordinary high water, enabled a channel to be maintained throughout the season in spite of the extraordinarily low stage of the rivers. This channel was narrow and irregular, but it was never less than 4½ feet in depth, and navigation was not interrupted.

Bayou des Glaises.—A special allotment of $2,500, made by Congress for work on this stream, was expended in removing snags, logs, leaning trees, etc., for a length of 39 miles from the mouth of the bayou.

New Orleans Harbor.—The work of bank protection heretofore carried on in this harbor has given satisfaction except in the lower part of the city, in the third municipal district. Here the spurs seem to have been located too far apart, and the bank has caved between them to a certain extent. It has in consequence been decided to increase the number of spurs and to revet portions of the bank between them with brush mattresses of the usual type. This work has been in progress during the last season, 744,000 square feet of mattress having been sunk between the old spurs, while foundations for four new spurs have been laid.

LEVEES.

In the fourth district there is a continuous line of levees on the right bank, from opposite Warrenton, Miss., to the Jump, 10 miles above the Head of the Passes, with the exception of a gap of 26 miles above the mouth of Red River. The total length of river frontage is 442 miles. There are four levee districts on this side of the river and three on the other. The upper one on the left bank is a new district, which includes the small basins lying between the bluffs and the river and distributed along the stream from Vicksburg to Baton Rouge. Below this latter place the levee line is continuous to Fort St. Philip, but in the upper or Homochitto district there are, as yet, only a few detached levees built by private parties.

During the past year work has been carried on in all these districts, except the one last mentioned, and has consisted in repairing, enlarging, and reconstructing existing levees. Not including the work involved in small repairs, the total yardage for the year was 2,852,740 cubic yards.

As there was no high water, there were no crevasses, and the season was unusually favorable for levee work.

Surveys have been made of the various small basins composing the Homochitto district, and as soon as the proper location for levees can be determined work on the more important ones will be begun.

Routine surveys, gaugings, etc., have continued throughout the year. For details see report of Captain Derby. (Appendix 7.)

The river and harbor act of July 13, 1892, made provision for the expenditure, by the Secretary of War, in stated parts during the four years beginning July 1, 1892, of $9,995,000 for the improvement of the Mississippi River and the building of levees, according to the plans and specifications of the Mississippi River Commission. From the sum appropriated by Congress for each of these years, the Commission has allotted $1,500,000 for the building of levees. As it is now about to enter upon the fourth and last year of this continuing appropriation, the Commission is in a position to state the results which will have been accomplished by the end of that time, on June 30, 1896, and to give an opinion as to the efficiency of this method of appropriation in its application to the improvement of the Mississippi River.

The levee system is designed to supplement the height of the river's natural banks, so as to confine the flood discharge, with the intention of deepening the bed by scour, and also of excluding its overflow from the fertile alluvial region on either side.

In a stream of the vast proportions of the Mississippi it is not to be expected that such partial treatment as it has yet received within the past ten years, in the building of levees, would have showed general

or conclusive results in the deepening of its bed. Its dimensions as well as the great range between high and low water, the frequent irregular fluctuations between these extremes, and also the unst character of the material of its bed and banks, and the conseq rapid changes in its course and regimen, seriously complicate the nomena, and render extreme care necessary in assigning causes to observed changes. The river has not been under scientific observa sufficiently long to establish such definite conclusions as have t applied to the navigable rivers of Germany and France.

The observations so far obtained by the Commission in the pros tion of its work and surveys generally seem to indicate that the pro of deepening is going on throughout those parts of the river wl sufficient progress has been made with the levees to cause a subs tial increase of the flood volume discharged between them, but fur observations are required to establish this conclusion.

In a discussion of this subject by General Comstock, forming par the report of the Commission for 1893, is a statement of the result observed at that date. In papers by Lieutenant-Colonel Suter and Professor Whiting, which accompany this report, is contained evide that the process of deepening, as the result of levees, is steadily g on. In connection with the last low water (1894) it was observed 18 of the 21 gauges from the mouth of the Ohio to Cairo show lower stage than was ever before known, while on no one of the nu ous tributaries, except the St. Francis, was as low a stage reache that year as had been previously known, as is shown in the follow tables:

Locality.	Low water of 1894.	Lowest water previous to 1894.		Di e
		Height.	Year.	
Gauges on Mississippi River.				
Belmont	0.79	1.39	1888	
New Madrid	1.67	4.12	1893	
Cottonwood Point	—1.45	—0.40	1891	
Fulton	1.81	1.60	1888	
Memphis	—1.40	—0.95	1872	
Mhoons Landing	—7.24	—2.60	1893	
Helena	—2.23	—0.18	1888	
Sunflower Landing	—0.34	2.10	1891	
Mouth White River	2.65	0.00	1872	
Arkansas City	—2.36	0.30	1887	
Greenville	—1.01	1.85	1887	
Lake Providence	—4.25	—3.85	1872	
Vicksburg	—5.31	—3.91	1887	
St. Joseph	—7.74	—4.00	1891	
Natchez	1.00	0.00	1872	
Red River Landing	—0.25	0.00	1872	
Bayou Sara	—2.73	—2.10	1889	
Baton Rouge	0.45	0.90	1877	
Plaquemine	—0.94	0.20	1891	
Donaldsonville	1.00	1.70	1891	
College Point	—0.91	0.00	1891	
Gauges on tributaries of Mississippi River.				
Pine Bluff, Arkansas River	6.70	4.70	1887	
Nashville, Cumberland River	—0.10	—0.40	1878	
Beardstown, Illinois River	5.70	0.00	1887	
Coles Creek, Missouri River	72.50	68.50	.....	
Cairo, Ohio River	2.81	—1.00	1871	
Monroe, Ouachita River	1.00	0.10	1887	
Alexandria, Red River	—2.25	0.80	1881	
Railroad Bridge, St. Francis River	0.52	0.04	1893	
Florence, Tennessee River	—0.10	0.56	1878	
Mount Carmel, Wabash River	0.70	—0.40	1891	
Clarendon, White River	6.20	4.07	1887	
Yazoo City, Yazoo River	—1.90	—4.30	1875	

NOTE.—Those gauges nearest the mouths of the tributaries are taken.

In order to illustrate this important fact more fully the following table is given. It shows the lowest gauge readings for the years 1883 and 1894 and their differences, those of 1894 being the lower. The gauges marked thus * are those in the vicinity of which levee building has been most active, and the relatively greater differences between the gauge readings of the two years at these points indicates the depressions of the bed which have followed levee construction.

Table of lowest gauge readings, 1883 and 1894.

Gauges.	Low water.		Difference.
	1883.	1894.	
Cairo	4.7	2.8	— 1.9
Belmont	4.6	0.8	— 3.8
New Madrid	4.7	4.7	0.0
Cottonwood	1.0	—1.4	— 2.4
Fulton	4.7	1.8	— 2.9
Memphis	1.9	—1.4	— 3.3
Mhoons*	2.4	—7.2	— 9.6
Helena*	6.4	—2.2	— 8.6
Sunflower*	5.3	—0.3	— 5.6
Mouth White River	6.8	2.6	— 4.2
Arkansas City*	4.2	—2.4	— 6.6
Greenville*	5.6	—1.0	— 6.6
Lake Providence*	4.2	—4.2	— 8.4
Vicksburg*	2.9	—5.3	— 8.2
St. Joseph*	4.2	—7.7	—11.9
Natchez*	4.9	1.0	— 3.9
Red River Landing*	4.0	—0.2	— 4.2
Bayou Sara*	.....	—2.7	.....
Baton Rouge*	3.1	0.4	— 2.7
Pinquemine*	4.5	—0.9	— 2.4
Donaldsonville	.....	1.0	.....
College Point*	1.5	—0.9	— 2.4
Carrollton*	0.5	0.0	— 0.5
Fort Jackson	.....	0.3	.....

It is also observed, as was stated in the report of the Commission for 1893, that the known increase of flood discharge caused by the improvement of the levees requires, after making allowance for the increase of velocity, a greater increase of sectional area than is gained by the elevation of the flood surface.

With the view of securing the most definite information on the subject of bed enlargement, all important in its bearing on the improvement of the river, the Commission has caused to be made during the past year a resurvey of that part of the river bed along which the greatest progress has been made in levee building, viz., the 200 miles between the mouth of the Arkansas River and Vicksburg. This has been done with great care and fullness, with cross sections about 200 meters apart.

Although the time which has elapsed between the first survey of this part of the river, in 1882, or between the commencement of active levee building, in 1884, and the date of this last survey is not as long as is desirable, still it is expected, from the great progress made in the levees and the extent of river included in the survey, that extremely valuable results bearing on this question will be reached.

Concerning the results of levees in excluding overflow from the rich lands on either side of the river the conclusions are more definite, and sufficiently so to justify the claim of the success of the levee system.

It may be well to precede a statement of these results by a short description of the alluvial region to be protected. This is divided by natural features which prevent the overflow of one from invading any other into seven great basins, as follows: (1) The St. Francis, on the

west bank, extending from Cape Girardeau to Helena, with a river frontage of 353 miles and an area of 6,706 square miles; (2) the Yazoo, on the east bank, extending from the Memphis Bluffs to the mouth of the Yazoo River, with a front of 358 miles and an area of 6,648 miles; (3) the White River, on the west bank, extending from Helena to the mouth of White River, with a front of 87 miles and an area of 956 square miles; (4) the Tensas, on the west bank, extending from the mouth of the Arkansas to the Red River, with a frontage of 348 miles and an area of 5,260 square miles; (5) the Atchafalaya, on the west bank, extending from the Red River to Bayou Lafourche, with 122 miles of frontage and an area of 6,195 square miles; (6) the Pontchartrain, on the east bank, extending from Baton Rouge to the Head of the Passes, with a front of 226 miles and an area of 2,001 square miles, and (7) the Lafourche, on the west bank, extending from Bayou Lafourche to the Head of the Passes, with a river front of 174 miles and an area of 2,024 square miles. The aggregate is 29,790 square miles, or 19,656,000 acres.

There are other smaller basins, which, as they allow but a small escape of flood water and are not of importance with a view to their reclamation, will not be further mentioned.

The alluvial land of these several basins is distributed among the riparian States as follows: In Missouri there are 2,874 square miles, or one-third more than the State of Delaware; in Arkansas there are 4,652 square miles, or the area of the State of Connecticut; in Mississippi there are 6,926 square miles, equal to all the cultivatable land in Egypt or the entire Hawaiian Islands, and in Louisiana 14,695 square miles, or 15 per cent more than the entire area of Holland.

The aggregate area in Illinois, Kentucky, and Tennessee is 643 square miles. The entire area of 29,790 square miles is equal to that of New England, excepting the State of Maine.

In all of these basins more or less progress was made in levee building before the war of the rebellion, mostly by riparian owners, and particularly in the lower basins. Below the Arkansas River, on the west bank, and Memphis, on the east, the lines were nearly continuous, but of such insufficient grade and section that numerous crevasses occurred whenever the flood was of average height. During this war, by neglect and flood and for military reasons, the destruction of levees was very great.

The present standard of levee building on the Mississippi River is generally a grade of 3 feet above the highest flood. In some locations of special exposure a higher grade has been used, while in others this has not been attained by half a foot or perhaps more. The slopes are generally 1 on 3, but are frequently built flatter in dangerous localities and in many cases where the height exceeds 12 feet a banquette of 20 feet or more in width is added on the land side. The levees are covered with a tenacious sod of Bermuda grass.

This grade has been established tentatively as the highest that up to the present time the combined resources of the General Government and the riparian States could attain. Experience has not yet been sufficient to justify a prediction as to the exact height which will be necessary when no escape of flood water as overflow is permitted. Therefore it is not claimed that a grade of 3 feet above the highest previous flood is final or even sufficient at present and on all parts of the river for the emergency of the very greatest flood, as that of 1882; but it is believed that it will restrain such large floods as those of the years 1891, 1892, and 1893, which on many parts of the river exceeded

any heights previously known. As more complete and more extended control is imposed on the floods it will doubtless require raising in certain localities.

By this course of making the improvement partial but general and uniform throughout the leveed basins, with the intention of raising them to a final grade and extending them throughout all the basins as the opportunity occurs and the necessity is developed, it is thought that the greatest and most economical results have been accomplished, particularly in protecting from overflow large interests already established and by securing the cordial cooperation of those riparian States having strong and active levee organizations.

The general condition of the levee system, as it will stand at the end of the fiscal year 1895–96, may be described as follows:

There will be a continuous levee protecting the lower part of the St. Francis Basin, extending from the highland below New Madrid down 108 miles to Pecan Point. Also, a levee extending from Horn Lake, below Memphis, to near the mouth of the Yazoo River, a distance of 325 miles, protecting the entire Yazoo Basin, and a line 77 miles long, from Helena to Scrubgrass Bend, protecting the White River Basin. The Tensas Basin will be protected by a levee line about 320 miles long, extending from the lower point of the highland on the south bank of the Arkansas to near the mouth of Red River. Below Red River, on the west bank, the levees will be continuous to the Jump, a distance of 282 miles, protecting the Atchafalaya and Lafourche basins, while on the east bank they begin at Baton Rouge and extend continuously to Fort St. Philip, a distance of 205 miles, protecting the Pontchartrain and Lake Borgne basins.

It may be confidently stated that by the end of the fiscal year beginning July 1, 1895, all these lines will be continuous and very nearly if not absolutely of standard grade and dimensions.

The table below shows the amount of expenditure and of levee yardage which will have been built during the four years of continuing appropriation from July 1, 1892, to June 30, 1896, both by the General Government and by the riparian States. This table is necessarily approximate, as it involves an estimate for a future year, and as the estimates for the past, for the United States and for State work, can not be made on the same basis, as is hereafter explained:

	Missouri.		Arkansas.		Mississippi.		Louisiana.	
	Yards.	Expenditure.	Yards.	Expenditure.	Yards.	Expenditure.	Yards.	Expenditure.
United States....	613,000	$88,000	9,986,000	$1,895,000	6,293,000	$1,050,000	12,368,000	$2,967,000
Riparian States..	1,387,000	208,000	2,071,000	355,000	6,109,000	1,112,000	21,566,000	3,874,000

There will probably be some balances left in the expenditure as given in the table for the United States. All engineering and contingent expenses are included except the rights of way, which have in all cases been furnished to the United States by the respective States.

In Mississippi engineering and contingent expenses and rights of way are not included in the expenditure, but only the aggregate sum of the various contracts.

In Louisiana engineering and contingent expenses have been included for only two of the four years considered. Of the yardage built by this State about 1,157,000, at a cost of $185,000, was placed in the State of Arkansas to secure the head of the Tensas Basin.

With these limitations it is believed that the table is useful in showing the magnitude of the work, the great progress made, and the full and liberal cooperation which has existed between the General Government and the several States interested.

The steady and rapid progress made and the increasing low rates which have been obtained are largely due to the confidence which has been given and the foresight which has been made possible by the system of appropriation which has prevailed since June 30, 1892.

The most notable difference is that this method admits of the prosecution of the work during the dryer and more favorable seasons of the year, whereas an appropriation in August, as is usual under the exigencies of legislation, forces it into the cold and rainy autumnal and winter weather.

The progressive reduction of rates attributable to this and other causes is well shown in a tabulation of prices in the third district for the four years, which is herewith submitted:

Average cost of levee construction in third district, improving Mississippi River, 1890–1895.

District.	From June 30, 1890, to June 30, 1892.			From June 30, 1892, to June 30, 1893.		
	Yardage.	Cost.	Average price per yard.	Yardage.	Cost.	Average price per yard.
	Cubic yards.		*Cents.*	*Cubic yards.*		*Cents.*
Lower Yazoo	979,145	$219,014.81	22.4	793,365	$168,526.96	21.2
Upper Tensas	935,844	177,596.20	19.0	1,202,884	248,802.65	20.6
Middle Tensas	695,159	154,159.47	22.7	460,267	85,706.21	18.6
Total	2,610,148	550,770.48	21.1	2,456,516	503,035.82	20.4

District.	From June 30 1893, to June 30, 1894.			From June 30, 1894, to June 30, 1895.		
	Yardage.	Cost.	Average price per yard.	Yardage.	Cost.	Average price per yard.
	Cubic yards		*Cents.*	*Cubic yards.*		*Cents.*
Lower Yazoo	785,642	$137,449.50	17.5	1,326,255	$148,422.64	11.2
Upper Tensas	1,468,184	241,692.37	16.5	2,247,898	263,183.93	11.7
Middle Tensas	673,632	109,209.91	16.2	708,211	90,178.14	12.7
Total	2,927,458	488,351.78	16.7	4,282,364	501,784.71	11.7

From the allotment of the fiscal year ending June 30, 1896, I have just placed under contract 680,000 cubic yards, at an average cost of 8.8 cents per cubic yard.

A continuance of the system of making appropriations above alluded to is earnestly recommended.

DREDGING.

As stated in the last annual report of the Mississippi River Commission, the experimental dredge, which had been ordered with the view of determining the feasibility of keeping the Mississippi River below Cairo open for navigation by dredging channels through the bars, was completed in the fall of 1894.

The plan originally had been to construct a dredge with two pumps at the bow, which could be operated simultaneously and discharge the dredged material through two lines of floating pipes attached to the stern of the dredge.

It was proposed to use the Reynolds screw pump, which had given excellent results both as to capacity and economy in pumping water

from Lake Michigan into the Milwaukee River, and seemed to be particularly well adapted for dredging purposes from the absence of bends or curves in the line of flow. But as this style of pump had not yet been tested in actual dredging, and as the Edwards centrifugal pump had been used so very successfully in dredging Gedneys Channel in New York Harbor, it was considered advisable to put one pump of each kind on the dredge boat. The two pumps could not be worked simultaneously and this reduced the capacity of the dredge by one-half, but it gave an opportunity to test the two different modes of introducing the material into the suction pipes; the one recommended for the Reynolds pump consisting in using water jets for scouring the sand in front of the suction pipe, while the Edwards pump had an attachment called a drag fixed at the end of the suction pipe which scooped the sand from the bottom.

This change furthermore reduced the cost of the dredge plant by requiring only about half the steam power and only one line of floating pipe.

The experimental dredge as constructed may be briefly described as follows:

The hull of the dredge is rectangular in shape, 140 feet long, 36 feet beam, and 8 feet depth of hold. Its draft is 4 feet. Two longitudinal bulkheads, extending from stem to stern, divide it into three compartments of about equal width, while three transverse bulkheads divide its length into four sections 30 to 40 feet long. The central compartment was left open at the bottom at the bow and stern forming two wells in which the suction pipes were placed. That of the Reynolds pump in the bow and that of the Edwards pump in the stern. The Reynolds pump was placed in the compartment next to the front well and as low in the hull as practicable to reduce to a minimum the elevation to which the sand and water would have to be lifted. The engine for driving it was placed close to the pump. The suction pipe, 28 feet in length, is made entirely of iron and is held near its upper end by a 4-inch steel pin, around which it revolves in a vertical plane so as to allow its lower end to be lowered to a depth of 12 feet below the water surface or raised above it.

The suction pipe terminates in a suction chamber 7 feet 6 inches in width, with gratings over the openings at the front and at the bottom for the admission of sand and water. A special valve operated from the deck regulates the quantity of water admitted to the chamber. To scour the sand in front of the suction head, six jets of water, with 2½-inch nozzles, issue from the suction head, loosen the sand, and bring it, well mixed with water, under the influence of the suction of the pump.

A special pump, with a capacity of 10 cubic feet of water per second under a pressure equal to a head of 25 feet, furnishes the water for the jets. It is placed with its engine in the same compartment with the Reynolds dredge pump. It takes the supply of water from the side of the dredge, delivers it through a 15-inch pipe, thence through two 8-inch pipes to the pressure head placed on top of the suction head out of which issue the six jet pipes.

After being raised through the suction pipe the mixture of sand and water is forced through a pipe laid in the starboard longitudinal compartment of the hull and through the stern. It carries on its outer end a 6-foot flexible rubber hose, to which the floating pipe may be attached. The floating pipe delivers the material at a distance, depending on the length of the pipe.

The Edwards pump and engine were placed at some distance from the after well and was connected by a pipe with the suction pipe. The latter is partly of iron, but had at its upper end a 17-foot hose, which permits it to bend sufficiently to be raised and lowered in the same way as the forward suction pipe. At its lower (downstream) end the suction pipe was provided with the drag, which is a casting bent upstream and around the inlet of the suction pipe, by which the material was scraped from the bottom and delivered into the suction pipe.

This pump discharges at right angles to the axis of the dredge into a pipe laid in the port compartment and thence through the stern, where the floating pipe could be attached as before described for the Reynolds pump.

The diameter of the suction pipes (except the suction heads at their ends) and of the discharge pipes of the dredge pumps is in all cases 30 inches.

Hoisting apparatus was provided for raising and lowering the suction pipes. The suction pipe of the Reynolds pump can be held securely at any depth less than 12 feet.

Steam for the various engines, driving pumps, hoisting apparatus, etc., is furnished by four steel boilers 34 inches in diameter and 28 feet long, placed on deck over the outside forward compartments. The dredge while operating is in both cases to move upstream.

The 30-inch floating pipe for carrying away the dredged material was to be made up of sections of pipe about 33 feet long and connected together by rubber joints of the same diameter as the pipe.

Each pipe is kept afloat by two air chambers formed by curved plates of iron connected by a flat plate on top 6 feet wide, at a height of about 8 inches above the floating pipe. These air chambers extend the whole length of the pipe to within 1 foot of each end, where they are closed by iron plates. The strain on the rubber joint is relieved by iron bars projecting from the ends of the sections and connected by pins. The dimensions of the air chambers are so arranged that when the discharge pipe carries 10 per cent of sand its top floats even with the surface of the water. It was assumed that 10 per cent of sand was the maximum admissible, but there is sufficient buoyancy provided that even if the percentage should rise to 50 the pipe would still be kept afloat. A plank walk is laid along the center of the pipe line for the convenience of the workmen. The air chambers are divided into six compartments, to provide against their sinking from accidental injury. These pipes have the advantage of exposing but little surface to the wind while in use and of having a low center of gravity and consequently considerable stability. On account of the expense of their construction a cheaper plan was afterwards devised in which the discharge pipe and two cylindrical chambers were held together by cast-steel saddles.

To move the dredge upstream while at work two steel cables are attached to two iron piles set about 600 feet upstream from the dredge and wound around the drums of two hoisting engines placed in the bow. The drums are operated at the proper speed to keep the suction head always against the material to be moved.

It was feared that ordinary anchors would not take sufficient hold in the sand to stand the pull on the cables, but might drag. It was therefore concluded to use for anchors cast-iron piles sunk 15 or 18 feet into the sand bottom by the water jet, the water being carried through the pile itself. The wire cables are attached to the piles by chains fastened to clamps around the piles. These clamps are fastened before

the pile is driven, so that when the pile is down the clamp is even with the bottom, thus bringing the strain of the cable as near the point of support as possible.

For keeping the dredge in line while going upstream smaller piles (6 inches in diameter) are set at some distance from the dredge on either side, according to the set of the current or the direction of the wind. Hemp ropes of equal length hold the dredge to the side piles.

To determine by actual measurement the quantity of sand and water delivered by the pumps a tank holding about 500 cubic feet was placed on the stern and so arranged that when full the discharge could be turned into the river. Although the tank was very small it was still hoped that an accurate result could be obtained by arranging for an instantaneous change of the current.

It is of the highest importance that the percentage of sand should be as uniform as possible when delivered to the pumps. It was assumed that 10 per cent of sand could be safely carried and delivered through a long line of discharge pipe.

Knowing the depth of the cut to be made at any particular place, it is easy to calculate the speed at which the dredge should be moved to make a clean cut and keep the pumps in such continuous and uniform motion as to furnish the percentage of sand required. Tables can readily be made to give the speed required for various depths of cut.

Another safeguard against overloading the pipes was provided by placing a gauge in the discharge pipe which at any moment would show the percentage of sand passing that point.

To ascertain approximately the velocity of the water in the pipe a velocimeter was provided.

Some preliminary experiments were made at St. Louis to ascertain the efficiency of the pumps and other machinery and the best method of manipulating them, which were continued after the dredge was turned into winter quarters at Memphis.

The contracts required that the pumps should deliver 50 cubic feet of water per second.

The Reynolds pump did not quite come up to the required capacity at first, but after some improvements had been made by the manufacturers it fulfilled the contract requirements. The engine for this pump proved to be entirely too light for the work it had to do.

The Edwards pump, after a few days' operation, largely exceeded the promised capacity.

The discharge pipe showed a tendency to double or kink. This was attributed to the reaction of the escaping water, but was afterwards found to be due to the centrifugal force of the moving water acting at the flexible rubber joints. It was entirely done away with by attaching a baffle plate across the mouth of the pipe line, about 4 feet from it and at right angles to it.

Some trouble was also encountered from the fact that the pipe line occasionally became overcharged with sand so as to even cause, in a few cases, the sinking of the pipes. This was due to the difficulty of regulating the amount of sand taken in by the drag, and also to the negligence of the workmen, who failed to report the gradual sinking of the pipe.

The weighing apparatus for determining the percentage of sand carried had not then been gotten into complete working order.

The Reynolds jet pump had to be entirely rebuilt before it would deliver water for the jets of sufficient quantity and pressure to scour the sand in front. It then did excellent work.

The result of these tests and experiments showed—

(1) That the Reynolds pump was very efficient and satisfactory, but that the construction of its engine was not sufficiently substantial.

(2) That the Edwards pump had greater capacity, and that its engine could be relied upon for steady work.

(3) That the jets used for loosening up the sand in connection with the Reynolds pump were preferable to the method of scraping used in connection with the Edwards pump.

It was therefore concluded before the dredge was put to work again to remove the Reynolds pump, to abandon the suction pipe of the Edwards pump, and to connect the Edwards pump with the suction pipe of the Reynolds pump. This was not the best arrangement to be made, as it increased the resistance to the flow from the great amount of curvature in the long suction pipe, but it was the most economical, it could be done in the shortest possible time, and the Commission was anxious to obtain some definite results in regard to the different questions which still remained unsolved in regard to the actual work of cutting channels through bars.

Early in July the dredge proceeded to St. Louis, the steamer *Titan*, which was to act as tender, with the assistance of another towboat, taking it up from Memphis. Thence it was taken about 2 miles above the Merchants Bridge, where a partly submerged sand bar allowed some preliminary experiments as to the best method of cutting channels, to systematize the work, and to get the men used to their special duties. Besides this, it was expected to ascertain, by a careful survey and soundings over the bar before and after dredging, with some accuracy the exact capacity of the dredge for pumping sand. Another object was to find out whether the method proposed for regulating the delivery by pulling the dredge upstream by cables and the use of side piles for guiding it would be effective. The pump worked very well and steadily, and excavated a large amount of sand. The attachment of a baffle plate at the end of the line of floating pipes effectually prevented any tendency to double up. The guide piles were very easily sunk and pulled out by forcing water through them. The pile driver and pumps were originally placed on the *Titan*, but it was found better to place them on a flatboat, which could be handled with less trouble and would always be at hand when wanted. The only question remaining unsolved was the actual quantity of material discharged by the pump. The ground over which the dredge operated had been carefully surveyed, and a party was constantly occupied taking soundings after the passage of the dredge; yet on account of the strong side currents, which shifted large quantities of sand, it was impossible to determine accurately the amount of material handled by the pump. It was evident that if any exact measurement was to be obtained it would have to be made by delivering the dredged material into a large barge.

As it was expected that the dredge could soon be towed to a bar, the following general system of operations was proposed and afterwards carried out:

Before the bar gets obstructive to navigation a surveying party is to be sent out to make a survey of the bar and its vicinity, and to make a map showing the contour lines from deep water above to deep water below the bar. The direction of currents is also to be observed and laid down on the map. From this map the engineer in charge is to decide where the channel line is to be cut. This line may be straight, or, in the case of long bars, may be composed of several straight lines or easy curves. The line of the cut having been fixed, it is to be marked

out by buoys 400 or 500 feet apart. The two anchor piles with the short chains attached are to be set 600 feet ahead of the point where the dredge is to commence, this point being at the lower end of the bar and on the contour line at the proper depth. On each side of the center line of the cut and 400 feet from it the 6-inch side piles are to be set, at about 250 feet apart, longitudinally. The dredge is then to be attached to the anchor piles by the chain and cables and dropped into its proper position. Hemp ropes 400 feet long, with loops at the ends, are to be carried from the bow and stern of the dredge to the side piles to keep the dredge from being driven out of line by wind or currents.

The floating pipe line is then to be attached to the stern of the dredge and the suction pipe lowered to the proper depth.

Pumping is then to be commenced and continued for a few minutes before the dredge is moved ahead. The material discharged is carried off by the current and dropped into deep water. When the end of the pipe line enters the cut (and when the bar is more than 1,000 feet long) it is necessary to draw its end 400 or 500 feet to one side of the cut in order that the dredged material shall not be dropped back into the channel or carried into it by cross currents.

The flexible joints permit this to be done by running a rope from the end of the pipe line to a pile sunk at the proper distance from the cut, and changed as the dredge moves upstream. This change can be made without stopping the dredging. The side piles are also taken up and replaced as may be required from time to time. The dredge cuts a channel about 10 feet wide at the bottom and 1 or 2 feet deeper than the suction head, with slopes depending upon the fineness of the sand.

When the dredge has nearly reached the anchor piles, operations are stopped, and the dredge held in place long enough to carry the cables ahead to the next set of anchor piles, which have already been set ahead by the pile driver. The anchor and side piles used before are taken up by pumping water through them.

It appears very desirable to finish the first cut in the shortest possible time, with the expectation that the current may deepen and widen it by its own velocity. If this does not occur, one or more outs may be made parallel to the first one until the necessary width is obtained, but it is believed that three or four cuts would generally suffice. A wider suction head would of course cut a wider channel, but with the same pumping power the rate of motion would be correspondingly slower, as this depends entirely upon the number of cubic yards excavated. In our experimental dredge the cut is only 10 feet wide at the bottom. It will be an advantage to lower the suction head to as great a depth as possible and to reduce the rate of motion of the dredge in order to get a wider channel. It was shown that with our experimental dredge, if a cut 6 feet deep is to be made, the speed of the dredge would have to be about one-half an inch per second, or 2.5 feet per minute.

About the beginning of August the river began to fall, and it was hoped that the dredge could soon be taken to a bar in the channel. Some of the bars above Cairo, as at Fort Chartres, Liberty Island, and Devils Island were therefore surveyed and everything made ready to commence operations, but as there was no appropriation for dredging above Cairo, it became necessary to take the dredge to the first bar below Cairo that appeared to be an obstruction. This was at Cherokee Bar. A survey was made and soundings taken. This survey showed that the channel to be cut was 7,000 feet long and that the current was very swift, and that the excavation would have to be made to the full

depth of 12 feet in order to allow for the material carried in by the current. The line of the cut was laid out, the piles sunk, and the dredge set to work. The pump worked most successfully, but the side currents swept in the sand so as to partially refill it while the dredge was working in another part; and, as we had only 500 feet of pipe line at that time, it was impossible to discharge the material at the proper distance from the cut. It was found also that if the dredge was left in the channel over night a bar was formed immediately below it. When this was discovered, the dredge was moved out of the channel at night and over Sundays, involving a great deal of extra labor and loss of time. In spite of these difficulties a practicable channel about 7 feet deep was made through almost the whole length of the bar. About this time some of the bars above Cairo became so shallow as to give only 3.5 to 4 feet of water, and this presented much more formidable obstructions to navigation than the Cherokee Bar, and as it was expected that it would have taken at least two weeks more to complete the channel at Cherokee to its entire length of 7,000 feet, it was decided to order the dredge to Devils Island Bar, a few miles above Cape Girardeau, authority to work the dredge above Cairo having meanwhile been obtained. A survey had been made of the bar, which showed that it had 3½ feet on its crest. The dredge arrived on October 17, 1894, and was set to work the next day on the line laid out, which was 1,600 feet long. A channel which allowed boats to pass through was cut in forty-six working hours (distributed over five days).

If the dredge had been provided with two pumps, as originally intended, and could have been worked continuously night and day, the same result could have been accomplished in less than one-fourth of the time, or in about twelve hours. The dredge was then employed in widening the channel by making parallel cuts and, with the exception of a few hours interruption caused by a towboat with several barges getting aground on the side of the channel, the channel has been in use by steamers ever since.

The Mississippi River Commission was about to start on its inspection tour, and as the additional 500 feet of floating pipe had just been received, it was decided to keep the dredge at Devils Island in order to let the Commission see it at work.

A large barge had also been fitted up for the purpose of making an accurate measurement of the quantity of sand and water discharged. This barge was arranged with a valve at the bow so that when the end of the discharge pipe was attached to the bow the stream could be directed into the barge for a definite length of time and then instantly turned into the river. The sand and water delivered during that interval of time could then be measured in the barge.

When the Commission arrived at Devils Island, on November 10, the dredge was in full operation, cutting a line parallel to the channel and adjacent to it. The pipe line, 1,000 feet long, was deflected to the side and discharged the dredged material 400 feet from the center line of cut. During the several hours of the Commission's visit the work was not interrupted for a single moment. It was to be regretted that the measuring barge had not been fully completed and could not be used. The Commission, however, directed a series of tests to be made, the results of which are given in an annexed table.

Twenty-two tests were made in all, of which the first six were made before the valve of the measuring barge had been properly perfected and were therefore omitted from the table. Of those contained in the table, No. 7 was made with the suction head fixed at 10 feet below the surface of the water and the remainder with the suction head 12 feet

below the surface. Nine of these tests (Nos. 7 to 15, inclusive) were made with 547.5 feet of floating pipe attached, and the remainder (Nos. 16 to 22, inclusive) with 1,002.5 feet of floating pipe.

In one test, No. 16, the material dredged was mud in sand; in No. 17 it was clay lumps in sand; in all the other tests it was clear sand.

On account of the facts stated No. 7 was omitted entirely from the calculations, and Nos. 16 and 17 taken separately.

The tests were therefore arranged for consideration in four sets:

I. Nos. 8 to 15, inclusive.
II. Nos. 18 to 22, inclusive.
III. No. 16.
IV. No. 17.

The following results were obtained from the first set: The measurements in the barge showed that the pump discharged 59.09 cubic feet of water and sand per second, as measured in the barge; that is, 9 cubic feet more than the contract called for. Of this amount 8.9 per cent was sand, or a slightly smaller percentage than had been expected. The measurements of the weighing apparatus indicated 11.55 per cent of sand, showing that the sand moved at a slower rate of speed in the pipe than the water. From these figures and the area of the cross section of the pipe the velocity of the sand in the pipe is found to be 9.2 feet per second. The velocity of the water, calculated in the same way, is 12.7 feet per second. The velocimeter showed the average velocity to be 11.9 feet per second. The dredge moved upstream at a rate of 147 feet per hour. The discharge of sand in cubic yards per hour was 702, and the total distance to which it was delivered from the suction head was 705.5 feet. The indicated horsepower of the dredge pump was 314, to which, if the 150 horsepower required to drive the jet pump be added, gives the total horsepower required for the dredge. This makes the indicated horsepower required to dredge and deliver at 700 feet 1 cubic yard of sand 0.644 H. P. It will be seen that the amount of sand discharged per hour with the same power through 1,160.5 feet of pipe was over 20 per cent less than through 705.5 feet of pipe, and that in sets III and IV the average discharge per hour was reduced from 537 cubic yards per hour to 338 and 364 cubic yards because of the presence of mud and clay. These results, with those from the other three sets, are given in the following table:

	I.	II.	III.	IV.
Total quantity discharged.....cubic feet..	63,933	42,007	8,792	7,179
Sand discharged.....do....	5,698	3,739	460	530
Water discharged.....do....	58,235	38,268	8,332	6,649
Percentage of sand.....	8.9	9.1	5.23	3.78
Time of delivery.....seconds..	1,082	928	187	194
Total discharge per second.....cubic feet..	59.09	45.26	45	37
Sand per second.....do....	5.266	4.03	2.51	2.73
Water per second.....do....	53.80	41.2	44.50	35.30
Percentage of solid material indicated by weighing apparatus.....	11.55	18.4	8.1	20.8
Area of pipe.....square feet..	4.91	4.91	4.91	4.91
Area occupied by sand.....do....	.567	.903	.39	1.02
Area occupied by water.....do....	4.343	4.007	4.52	3.89
Velocity of sand per second.....feet..	9.2	4.4	6.4	2.7
Velocity of water, by velocimeter.....	11.9	9	11	12
Velocity of water, by weighing apparatus, per second.....feet..	12.7	10.4	9.9	9.5
Rate of motion of dredge per hour.....do....	147	143.7	163.8	90
I. H. P. of main engines.....	314	302	306	293
I. H. P. of jet pump engines.....	150	150	150	150
Total I. H. P. in operating dredge.....	464	452	456	443
Discharge of sand per hour.....cubic yards..	702	537	338	364
I. H. P. per cubic yard.....	.644	.841	1.36	1.22
Distance from suction head to point of delivery..feet..	705.5	1,160.5	1,160.5	1,160.5

We may, therefore, rely upon the delivery, under ordinary condition of about 550 cubic yards of sand per hour by the experimental dredg or working day and night, as it is now being remodeled, it will remov 13,000 cubic yards per day.

The Commission also directed that several surveys should be mad of Devils Island Bar at intervals of several weeks. The first surve was made November 27, and showed a deepening for 400 feet from th lower end of the channel upstream since the previous survey of Noven ber 8. The second survey was made December 12 and 13, and showe the channel unchanged in position, but filled up slightly at the low end and in the middle.

The Commission has since then authorized the remodeling of th dredge by placing the Edwards pump and engine close to the suctio pipe in the front well, removing the tank and extra pipes, which are n longer needed, providing quarters for a double crew for working nigh and day, providing an electric-light plant, and making a number o smaller improvements, as suggested by the experience gained from th experiments.

In June the Commission passed a resolution authorizing the constru tion of another dredge and dredging plant, similar in general respect to the one already built; but as it appeared probable that, if an invit tion were issued to dredge builders all over the United States to subm plans or devices for dredging the Mississippi River, new and more pe fect designs might be obtained, on September 18 a circular was sen out, under the direction of the committee on dredges, inviting form plans and suggestions as to the methods and machinery best adapte to the work, which was as follows:

The Mississippi River Commission is desirous of obtaining one or more dredges suitable construction to be used on the low-water bars of the Mississippi River wi a view to the improvement of the channel for navigation at its lowest stages.

The following is a general description of the character of the work to be done:

At its flood stages the Mississippi carries great quantities of sediment, enough which it drops at the crossings between bends to build heavy bars at those point As the river falls these bars, although partially cut away by the falling wate remain as obstructions to low-water navigation. The river flows over them in broad, thin sheet, with a maximum depth sometimes of as little as 5 or 6 feet. Th quantity of water flowing is at all times sufficient for profitable navigation if it a portion of it were concentrated in a narrow channel.

It is proposed to effect this concentration by dredging channels through the ba in the expectation that the water will occupy those channels and by the erosion its flow keep open and enlarge them. It is considered vital to the success of th work that each channel shall be cut entirely through the bar as quickly as possibl The danger to be feared is the filling up of the dredged channel before the flow the river takes possession of it. For this purpose a dredge of large capacity will b required. It is considered that it should be able to take up at least 1,600 cubic yar of material per hour.

The material to be moved is principally sand. Some deposits of small grav mixed with the sand may be found, but it is not anticipated that they will b numerous. It will be necessary to deposit the dredged material so far from th dredged channel that it will not be carried back into it. Whether this can best b effected by some system of conveyors which will deliver the sand in the rear of th dredge in the deep pool below, or by long lateral delivery pipes, or other method, one of the questions to be considered.

The bars vary from 1,000 to 5,000 feet in length between the 10-foot contours. Th dredge should be capable of floating and working in water as shallow as 5 feet an in a current of 6 feet per second.

The method of moving the dredge on the bar while at work, as well as the metho of disposing of the dredged material, must be carefully considered and clear explained, but it is not considered necessary that the dredge should be provide with propelling power to move from one bar to another.

It is supposed that the form of dredge most suitable to the work is a pump dredg but that question also is open to further consideration. The maximum depth of exc vation below the water surface contemplated is 12 feet. It will be expected to u

a steel hull and build the dredge in the most substantial and durable manner throughout.

Based upon the foregoing description of the work to be done and the conditions under which it is to be done you are invited to furnish the secretary with any information within your convenient reach bearing upon the subject. If you have made, or can make, a dredge which you believe to be suitable for the work, you are invited to send a description of it or information where such a one can be seen in operation, together with any other information upon the subject.

It is desired to have the dredge ready for use July 1, 1895, and the Commission is prepared to contract for its building as soon as its style and construction can be determined upon and plans and specifications prepared.

Please also state upon what terms you will furnish plans for a dredge which, if built, will be accepted on condition of its complying with the foregoing requirements.

The Mississippi River Commission will meet at St. Louis on November 8, and it is desirable to have this information or as much of it as is practicable in the hands of the undersigned committee on dredges as soon as possible after November 1. If further information is required it may be sought from either member of the committee or the secretary of the Commission.

Maj. B. M. HARROD,
Masonic Building, New Orleans, La.,
Col. HENRY FLAD,
3400 Franklin Ave., St. Louis, Mo.,
Committee on Dredges.

First Lieut. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

This circular letter was sent to fourteen addresses and replies were received from several parties, from which the committee on dredges selected those which seemed to possess merit, as follows: (1) Lindon W. Bates, (2) The Bucyrus Steam Shovel and Dredge Company, and (3) The New York Dredging Company, George W. Catt, president. The committee carefully examined the plans submitted and made a report to the Commission, recommending the following:

That the three companies who have already sent communications to the committee on dredges in reply to their circular, to wit, the Bucyrus Steam Shovel and Dredge Company, the New York Dredging Company, and the American Hydraulic Dredging Company, be invited to prepare full drawings and explain all the features of their proposed dredge and dredging plant, together with bids giving the price for which they will furnish to the Government one completed dredge ready for pumping, including the dredge hull, pumps, engines, suction pipes with cutters or other device, discharge pipe, and all other apparatus for pumping sand, and for other appliances which they may consider necessary besides the above named for disposing of the sand and operating the dredge. This dredge shall have an estimated capacity of 1,600 cubic yards per hour. The bidder may add a separate estimate for any devices or appliances whose use he may desire to urge.

Each bidder shall also bind himself, in case his plan is accepted, to deliver the dredge and dredging plant on or before August 1, 1895, and in case of noncompletion on that date there shall be deducted from the contract price $250 for every day after that date required for completion.

Each company furnishing such plans to the committee on or before the 10th day of December, 1894, shall receive in payment therefor the sum of $1,500.

From the plans submitted the committee shall select the one which is in their opinion best adapted to the work to be done, taking into account not only the cost of the separate parts, but also the methods proposed for operating it.

The following requirements are considered necessary in the construction and operation of any dredge, and shall be inserted in the specifications accompanying the contract.

Requirements for a dredge with an estimated capacity of 1,600 cubic yards of sand per hour:

The hull must have a steel frame, strongly braced and so bulkheaded as to prevent sinking in case of the filling of any two compartments. It shall be covered with five-sixteenths inch steel plates, with three-eighths inch plates at angles and exposed places, such as the water line. The deck shall be one-fourth inch thick. When fully equipped for work, and with a supply of coal for twenty-four hours' operation, the draft must not exceed 4 feet 6 inches. Its width should not exceed 40 feet.

The dredge must also be fully and specially provided with the means of a straight upstream movement, with one or more suctions in front which can cut to 20 feet below the surface of the water and will make a cut wide enough for the passage of the hull of the dredge, and one or more discharge outlets through the stern, with an equal number of floating pipe lines (or pipes supported by pontoons) each 1,000 feet long, and capable of and provided with means of deflection for 500 feet from the axis of the channel.

The boat may be provided with any other movement in operation provided it does not interfere with the before-described movement and the advantages justify the additional cost.

The engines shall be triple expansion, of marine type, and directly connected with the main pumps. The weight of each pump shall be given, as well as the weight of each engine, whether used for the main or supplementary pumps or warping drums. A list of duplicate parts shall be given which it is proposed to furnish.

Other information concerning all parts and the proposed power, speed, steam, and fuel consumption is requested, as well as a description of any especial advantages that may belong to the design or construction.

The capacity of the dredge, together with the strength and workmanship of all parts of the plant, will be given great weight in the selection of a design, and weakness of construction will be considered a fatal defect.

It is not desired that the dredge shall be provided with the means of self-propulsion.

Quarters for the crew are not desired on the dredge.

Pile drivers, quarterboats, and tugs or tenders are not to be furnished.

All piles and lines are to be furnished.

The operating expenses for a sixty days' test are to be paid for by the Government.

Before the dredge and dredging plant are accepted and paid for by the Government they shall be subjected to the following tests:

A test for determining the capacity of the pumps to lift and discharge material. This test shall be made by placing the dredge at work at some point on the river fixed by the United States engineer where an ordinary sand may be obtained at the average depth of cutting.

They shall discharge through 1,000 feet of pipe each with the pumps running at their average speed, and without applying a forced draft to the boilers, into a barge fitted up for the purpose in such a way as to determine separately the respective amounts of sand and water discharged per hour.

If the quantity of sand delivered is less than 1,600 cubic yards per hour, a deduction shall be made from the contract price which shall be proportional to this deficiency.

If the quantity of sand delivered is greater than 1,600 cubic yards per hour, a premium shall be paid for the dredge directly proportional to this excess, not, however, to exceed 50 per cent of the contract price.

These tests shall be carried out at the expense of the United States Government.

Partial payments may be made, but 25 per cent of the cost will be retained until the final acceptance of the dredge and apparatus.

On November 10 the Commission approved the recommendation of the committee as a basis for soliciting bids, and the parties named were requested by letter to submit plans and proposals for the construction of dredges in accordance therewith, to the committee on dredges on December 10, at the office of the secretary in St. Louis. Upon the selection of one design by the committee, the President of the Commission was authorized by the Commission to request the Chief of Engineers to approve the building of such dredge by contract without advertisement. The contract to be made by the officer in charge of the first and second districts, and the building to be done under his supervision.

The committee met on December 10 in St. Louis, and after carefully canvassing the merits of the three plans submitted, recommended to the President of the Commission the adoption of Mr. Bates's designs. This was approved by the Chief of Engineers and Secretary of War, and the contract made as directed. The machinery is being built at Sparrows Point, Md., the floating pipes at Springfield, Ill., the hull and other parts at Pittsburg, the boilers at St. Louis, and the cutters at Chicago.

If the dredge fulfills the expectations of its designer it will excavate about 40,000 cubic yards per day of twenty-four hours, which, with the 15,000 cubic yards per day of the experimental dredge, will make a total of 55,000 yards per day, or in twenty working days a quantity equal to the amount previously estimated by the committee on dredging as being necessary to make a navigable channel between Cairo and the Red River.

One or more additional dredges will, no doubt, be required to provide against breaking down of machinery or other emergencies, and to reduce the time required to make the first cut through all the bars and to keep the channels open. This question can be determined from the experience gained during the next season's work.

SEPARATION OF THE MISSISSIPPI AND RED RIVERS.

In the river and harbor act of Congress of August 17, 1894, appears the following provision:

> At the head of the Atchafalaya and the mouth of Red River, Louisiana, for the rectification thereof: Continuing improvement, seventy thousand dollars, of which two thousand five hundred dollars may be used in improving Bayou des Glaises, in the parish of Avoyelles, and the said Commission is directed to report to Congress in their next regular report their views on the advisability of effecting a separation between the Mississippi and Red rivers at the present junction thereof and maintaining navigation between the same through Bayou Plaquemine or by means of a canal.

Under this provision it becomes the duty of the Commission to submit their views upon the question of the complete separation of the Mississippi and Red rivers.

A proper solution of the problem of river improvement presented by the peculiar features of the flow of the three rivers—the Mississippi, Red, and Atchafalaya—is one that has engaged the attention of many engineers, and has for years been a matter of serious study of the Commission. The features of the case, and various projects proposed for a proper treatment of the locality, have heretofore been presented and discussed in the published reports of the Commission. It is therefore not deemed necessary at this time to discuss them further than to restate some of the views of the Commission, and to present facts relating to changes that have taken place in the condition of the locality, and changes that may be looked for in the near future. The two main features of the problem to be constantly kept in view are the navigation of the rivers and the control and disposition of flood waters, and it is impossible to deal with the subject in any method that does not adequately provide for both.

In its report of December 19, 1884, the Commission discussed various projects for the rectification of the Red and Atchafalaya rivers; among others, the project upon which they are now called upon to express their views, viz, the separation of the Red and Atchafalaya from the Mississippi. The following is an extract from that report:

> The separation of the Red and Atchafalaya from the Mississippi River has been proposed by extending and connecting the levees on the right bank of the Mississippi, above and below Old River, with a dam across that channel. This dam would have to be constructed with the same methods and materials as that previously discussed for the Atchafalaya. While it would not be of equal magnitude with that dam, either in length or height, or in the depth of water in which it must be built, the foundation would be in the loose deposit with which the bed of Old River is filled. The opening of the Plaquemine route, as previously described, would also form part of this plan. The discharge below Red River, on the basis of the flood of 1882, would be increased 355,000 cubic feet per second, or to 1,950,000, which would still require some elevation of levees below.

The connection of the dam with the adjacent levees would be more expensive than in the previous plan. Estimates are submitted without recommendation.

Cost of dam	$1,200,000
Connecting adjacent levees, 2,000,000 yards, at 25 cents	500,000
Locks and improvement of Plaquemine, Grand, and Atchafalaya rivers	1,561,620
To make secure present levees below Red River, assumed, as before, at a mean raise of 2 feet in their grade	2,872,500
To provide for the increased discharge below Red River consequent upon the execution of this plan would require an additional raising of grade, which, assumed in this case at 1 foot mean raise, would require	1,927,500
Total	8,061,620

In the same report the Commission presented a project of their own, as follows:

PLAN FOR THE RECTIFICATION OF THE RED AND ATCHAFALAYA RIVERS BY PREVENTING FURTHER ENLARGEMENT OF THE LATTER STREAM AND RESTRICTING ITS OUTLET CAPACITY.

The object sought to be accomplished in the plan which is now described is the control of the outlet discharge through the valley of the Atchafalaya and the checking of the enlargement of its bed.

It is not the opinion of the Commission that the diversion of the Red River into the Mississippi is of the importance to the maintenance and improvement of the main stream that would render expedient the expenditure and risk that would be incurred by the magnitude of the project and the precautionary work necessary on the lower levees. Any reasons in favor of this plan are valid only in connection with the navigation of the tributary.

To some extent the repair of existing levees along the Tensas front, now in progress, will tend to reduce the strain upon the Atchafalaya, but to provide absolutely against any injury from the augmentation of floods in the main river below some increase in the height of the levees below Red River will be necessary in this or any of the projects hereinbefore discussed.

The plan is as follows:

A series of brush dams should be placed in the Atchafalaya, with the upper one below the Bayou des Glaises, and the others at intervals not exceeding one-quarter of a mile. These dams should be built up to just below low water. It is the intention that these dams shall permit the passage down the Atchafalaya of a volume equal to the flood discharge of Red River, and in construction their height and the width between spurs can be so adjusted as to accomplish this result. It is also entirely practicable that these dams should be so located and constructed as to form part of a high-water dam, should the building of such be specially directed by Congress.

They should be constructed with a sill not less than 300 feet wide, up and down stream, and extending transversely up to the high-water banks. Above low water they should be heavily riprapped. The dam should be built upon this sill with concentric and diminishing cribs, constructed as those now being used in New Orleans Harbor. While the ends of these cribs would reach about to low water, their concentric position would leave a depression not less than 5 feet deep over the middle of the crest to afford at all stages access to the navigation of the Atchafalaya.

The design for the dams as described has been used for purposes of estimate. If constructed, the details may be materially modified.

From the levees on either side of the Atchafalaya, and opposite the ends of the dams, earthen spurs should be built out as far as possible. These spurs, and any surfaces of adjacent levees or banks, where necessary, should be substantially riprapped. These spurs and the levees with which they connect, extending up the left bank of the Atchafalaya to Old River and thence to the Mississippi, and also along the south side of the Bayou des Glaises, should be raised above any overflow.

Estimates for this project.

Six dams, with riprap and spurs, at $160,000 each	$960,000
Raising adjacent levees	250,000
To make secure present levees below Red River, assumed as in previous cases at 2 feet mean raise	2,872,500
To provide for the increased discharge below Red River, consequent upon the execution of this plan, would require an additional raising of grade, which, assumed as in the two preceding cases, at 1 foot increase of mean height, would cost	1,927,500
Total	6,010,000

Within a few weeks past the Commission made a careful personal inspection of the Atchafalaya River throughout its entire length. The water was at a low stage, and the opportunities for an examination of the stream and its banks were good. For a short distance from its head it has high banks and a deep capacious channel, which is gradually, but not rapidly, increasing in size. As it descends the channel grows narrower and shallower and the banks lower, and the evidences of recent enlargement gradually disappear. It is obvious that a large part of the water which enters between the high banks at the head is dissipated over the low banks below and finds its way to the Gulf in the form of general overflow. This overflow is so impeded in its progress by the dense forests of the swamps that it moves but slowly and soon piles up to an elevation which limits the discharge from above.

Nearly if not quite all the water which flows down the Atchafalaya at the present time during flood stages comes from the Red and Black rivers and the Mississippi overflow into the Tensas Basin. There is now no tendency in lower Old River to enlarge; on the contrary, it appears to be closing. While present conditions continue there is not, in the opinion of the Commission, any immediate danger that a deep-water connection will be formed between the Mississippi and the Atchafalaya. On the contrary, there seems to be more danger that the bed of the Old River will close and so sever the low water of the Red and the Mississippi rivers by a natural process, though of the future course of these changes it is impossible to affirm anything certainly. But the complete closure of the levees on the Tensas front, an event likely to occur at an early date, will change very materially these conditions, and at flood stages of the Mississippi coincident with relative lower stages in the Red there would be likely to be a large outflow through the Old River. If this were left entirely unrestricted there would be danger of changes in the channels of Old River and the Atchafalaya, which might occur with suddenness and make their subsequent correction very difficult. The possible consequences of such changes would be so grave that no reasonable precautions against their occurrence ought to be omitted.

The submerged dams proposed in the last-mentioned plan will contract the present discharge capacity of the Atchafalaya only slightly, so that unless they shall be supplemented by levees to prevent the entrance of overflow water into the Atchafalaya Basin the quantity of Mississippi water escaping into that basin will continue substantially unchanged.

This leads to the consideration of the Atchafalaya as an outlet and to the question of its closure or restriction as such. The Commission entertains no doubt of the truth of the general proposition frequently heretofore stated, that the tendency of an outlet of substantial discharge is to impair the efficiency of the main channel below it. The complete closure of the Tensas front will transfer the discharge of the present outlet along that front to the mouth of Old River and the space between that point and the foot of the Tensas levees. That the tendency of a permanent outlet so large and so sharply localized will be to impair the main channel below seems certain. The extent and rapidity of such impairment it is impossible to predict, but that it may result in the formation of a bar or series of bars great enough to obstruct navigation and in the abnormal widening of the channel, which is the usual concomitant of such bars, is possible.

The prevention of this escape can be accomplished only by cutting off the overflow into the Atchafalaya Basin by levees across its head. These, by preventing high water outflow through Old River, would also add to the security of that channel against dangerous enlargement, and so constitute a logical part of the plan proposed, whether that be considered as a means for the closure of an outlet merely, or as a precaution against the divergence of the Mississippi into the Atchafalaya Basin.

But, for the reasons already stated, the levees across the head of the Atchafalaya Basin can not be constructed without exposing the country on the main river below to disastrous overflow until the levees below Red River shall have been raised, and until that time the execution of that part of the plan must necessarily be deferred. The extent of such necessary additional levee height below Red River, and the probable cost of it, are given in connection with the statement of the first plan, hereinbefore described.

The present recommendation of the Commission is confined, therefore, to the construction of the submerged dams described, designed to prevent further enlargement of the Atchafalaya.

The keeping open a navigable channel from the Red River into the Mississippi River is not necessarily connected with any of the projects hereinbefore described, but in connection with the last plan described could, it is believed, be promoted by the following work. The limit to this improvement is the bar which invariably forms in the mouth of a tributary under the influence of back water from the Mississippi, and which the discharge of the tributary is unable to remove. Thus, the mouth of the Missouri goes down to 3½ feet, and of the White and Yazoo to about 3 feet.

It has been proposed to effect this by placing a low-water dam across Old River, between the Red and Atchafalaya, whose crest shall have an elevation of about 10 feet

above the obstructions in upper Old River, and thus deflect the Red River, when below this stage, down upper Old River, which, before the present conditions induced by the enlargement of the Atchafalaya, was the natural and better channel. The redevelopment of this channel would probably require the assistance of dredging and spur jetties; for which no reliable estimate can be made.

It is probable that work of this description would still be required if the entire flood discharge of the Red River were deflected in this direction. The cost of dam would be $125,000; probable cost of dredge and jetties, $275,000; total, $400,000.

While it is believed that the effect of this plan will be to deepen the access to Red River, and confine the difficulty of navigation, which now extends over 6 miles to its immediate mouth at the Mississippi, it is doubtful if the condition there admits of a depth of navigation greater than is now found at the mouths of other tributaries, or at the mouth of Red River itself before Shreves Cut-off. The plan is therefore submitted as presenting this limited advantage, with an estimate, to enable Congress to judge of the advisability of its execution.

In pursuance of the plan outlined in the project of the Commission work has been in progress as follows:

In the Atchafalaya River, two of the dams have been constructed.

In Old River between the Red and Atchafalaya, a dam has been placed, but not built up to the full height designed.

On the banks of the Mississippi below the mouth of the Red a considerable amount of levee work has been done, resulting in a material strengthening of the line as a whole and increasing the height of parts of it.

A powerful hydraulic dredge has been constructed and operated in keeping a navigable channel through lower Old River, and will under the adopted project be used in opening upper Old River.

While the above-mentioned work, which relates more or less directly to the problem of the rectification of the rivers at their points of junction, has been in progress there has been a vast amount of levee building along the banks of the Mississippi above the mouth of the Red. In the past four years that work has been actively pushed by national, State, and local authorities, with the result that at this time the whole Tensas front, extending from the mouth of the Arkansas River to the mouth of the Red River, with the exception of about 26 miles above the mouth of the latter river, is effectually closed to the escape of flood waters by a line of levee that is expected to withstand a greater flood than any that has yet been recorded.

The effectual closing of this long line, about 365 miles in extent, and the almost certain delivery by the Mississippi in its channel at the mouth of the Red of 500,000 cubic feet per second more water in floods like that of 1882 than has ever heretofore been delivered in the Mississippi's channel at that point will produce a change in the probable flood conditions of the Mississippi below the Red, in Old River, Red, and Atchafalaya, which will undoubtedly very seriously change the relations of the three rivers.

Heretofore when the floods have reached their maximum at Red River Landing the flow through Old River has been toward the Mississippi, due to the large amount of overflow water which had escaped from the Mississippi along the Tensas Front, thus reducing the volume in the main channel above Red River and returning a considerable portion of the escaped water at the mouth of Red River. Hereafter a different state of affairs may be expected. At the maximum of the flood at Red River Landing a large volume of water must pass from the Mississippi into the Atchafalaya through Old River, though there will undoubtedly be an increase over previous flows in the channel of the Mississippi below the mouth of the Red. The result of this outward flow from the Mississippi through Old River will, it is believed, induce a scour which will materially improve the navigable condition of Old River at low water,

owing to the deepening of its bed, and may in fact produce an undesirable amount of scour, which will necessitate the placing of works for its restriction.

The complete separation of the Red from the Mississippi River would require the building of a continuous line of levee connecting the end of the existing levee at the foot of the Tensas Basin with the levee below the mouth of Old River, and, crossing Old River, the old bed of the Mississippi. This crossing of the Old River bed would undoubtedly be a work of considerable magnitude and difficulty, owing to the unstable nature of the bottom and the great head of water that it would at times be required to withstand. With the sudden closure of this outlet for the flood waters, the whole volume of the Mississippi would be precipitated upon the valley below Red River Landing, increasing the flow by something like 500,000 cubic feet per second. The question naturally arises, Can this be done in the present condition of the bed of the lower river without fear of devastation and ruin? Heretofore, notwithstanding the large escape of flood water through crevasses along the Tensas Front, there has passed in the Mississippi at Red River Landing below the mouth of Red River as much as 1,500,000 cubic feet per second, but not more than 1,296,000 feet has passed Carrollton, showing that the river was unable to deliver to the Gulf through its channel the water that passed the Red River Landing. The improvement of the lower levee line in the past few years will undoubtedly permit the passage through that region of a greater flood than has yet passed, but until the bed of the river has had time to accommodate itself to a much greater increase of flow it would certainly be hazardous to force into it the volume that would result from a closure of Old River, which is estimated at about 2,000,000 cubic feet per second.

That Red River some time in the distant past flowed into the Gulf in a separate and distinct channel of its own, entirely unconnected with the Mississippi, seems to be almost a certainty, and the restoration of that condition would, from some points of view, appear to be logical, and would eliminate some of the complexities of the present situation, and, furthermore, might at some future time be considered desirable and advisable. The opening of a navigation route between the Mississippi and the Atchafalaya and Red rivers, through Bayou Plaquemine is, in the opinion of the Commission, an undertaking that should be pushed to completion at an early date, for the opening of that route can not be anything but advantageous in the prosecution of any project for improvements at the mouth of Red River, and it has sufficient merit as an independent route to commend it.

We are therefore of the opinion that the separation of the Mississippi River from the Red at their present junction, through Old River, would establish a condition more favorable than now exists for the navigation of both streams and for the protection from overflow of the region along their banks, and would accomplish these objects more surely than any other plan.

The natural tendency at this time is in the direction of such separation. Satisfactory connection for navigation between the Mississippi and the Red can be afforded by locks on the Plaquemine and the improvement of that stream and the Atchafalaya River.

The difficulties presented by this plan are that it would require a large increase in the levees below Red River and some increase in those for some distance above, and that the dikes across the Old River would be very difficult and costly to build and maintain.

If the Plaquemine-Atchafalaya route were thoroughly improved, as is easily practicable, and Old River left to natural forces, high-water navigation would still be maintained by Old River for a long period, while low-water navigation by the Plaquemine would be more constant and certain than it is or can be made by Old River.

If a tendency to scour should develop at any time in Old River, it could be checked by sills.

If the closure of the outlet through Old River should be determined upon, a large appropriation, available for immediate use, would be necessary.

CONSEQUENTIAL DAMAGES TO LANDS.

Since the last report of the Commission information has been requested by the Law Department of the Government respecting damages to certain lands by overflow said to have been caused by increase of flood heights in the Mississippi in consequence of the building of levees under the direction of the Commission, such information being desired for the guidance of that Department in the defense of two suits pending in the Court of Claims to recover such damages. All the information obtainable on the subject was furnished, and is accessible in the office of the Assistant Attorney-General, and the suggestion was made that information of similar character respecting the effect of levees built under State authority should be added to that furnished by the Commission, which, it is understood, has been done.

The general subject of such injuries to lands in small basins was referred to in the last report of the Commission. (Appendix XX, Annual Report of the Chief of Engineers for 1894, p. 2713.) The Commission adheres to the views there expressed and renews the recommendation there made that some provision be made by Congress for the adjustment of the equitable claims of landowners in such cases.

To what was then said it may be added that further consideration of the subject has shown in still stronger light the difficulty attending it. To ascertain the variations of flood heights from year to year, to trace the causes of those variations to their sources, to determine how far, if at all, they were due to levees built by the United States, and how far, if at all, they were due to levees built by the States or local authorities, and how much, if any, of the total injury suffered by a landowner is due to an increased flood height caused by such levees, and how much, if anything, ought to be recovered from the United States for such injury, is a problem which appears to the Commission to be incapable of solution except by legislation designed and adapted to the peculiar and extraordinary circumstances of the case.

RECOMMENDATIONS AND ESTIMATES.

The Commission beg leave to call the attention of Congress to the fact that the last of the continuing appropriations provided for by the act of 1892 is now about to be expended. The wisdom of the policy of authorizing the letting of contracts in advance of appropriations and extending over a term of years has, in the experience of the Commission, been amply vindicated. In the matter of levee contracts alone the price per cubic yard of earth has been reduced from 21 cents to 9 cents, thus allowing a very much greater amount of work to be done than would have been possible at the prices formerly prevailing. This advantage and the further one of the ease and certainty with which

work can be laid out and carried on are so great that the Commission venture to express the hope that Congress will provide for the extension of this method of appropriation over another term of years.

Estimate of funds of the Mississippi River Commission for the fiscal year ending June 30, 1897.

For improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries and clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$3,000,000
For improving harbor at:	
New Madrid, Mo	60,000
Memphis, Tenn	72,000
Greenville, Miss	150,000
Delta Point, La	150,000
Natchez, Miss., and Vidalia, La	385,000
New Orleans, La	300,000
For improvement at head of Atchafalaya and mouth of Red River, Louisiana	300,000

FINANCIAL STATEMENT.

Appropriation for improving Mississippi River:		
Balance on hand May 31, 1894		$670,067.62
Appropriated—		
Act of August 17, 1894	$485,000.00	
Act of August 18, 1894	2,665,000.00	
Act of March 5, 1895	2,665,000.00	
		5,815,000.00
Total		6,485,067.62
Expended June 1, 1894, to June 30, 1895		2,794,205.75
Balance on hand June 30, 1895		3,690,861.87
Distributed as follows:		
Levees		1,779,900.74
Channel works		594,969.46
Harbors and bank protection		268,520.41
Red and Atchafalaya		71,006.12
Surveys, gauges, and observations		212,046.38
Plant, Mississippi River Commission, and miscellaneous		212,257.72
Dredges and dredging		549,161.04
Unallotted		3,000.00
Total		3,690,861.87
Approximate outstanding liabilities and amounts covered by existing contracts		1,073,676.79

I subscribe to the statements of the report only so far as relates to the record of work done during the year.

G. L. GILLESPIE,
Lieut. Col., Corps of Engineers, President Mississippi River Commission.

B. M. HARROD.
ROBERT S. TAYLOR.
HENRY FLAD.
AMOS STICKNEY,
Lieut. Col. of Engineers, U. S. A.
HENRY L. WHITING,
U. S. Coast and Geodetic Survey.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

MINORITY REPORT.

I concur in all the preceding report, with the exception of that portion which refers to the separation of the Mississippi and Red rivers.

The question of the separation of the Red and Atchafalaya river systems from the Mississippi involves two interests of importance. One is the navigation of these rivers, their tributaries, and connections, and the other is the whole riparian interest of Louisiana along the Mississippi below the mouth of Red River.

As long as Old River is left open as at present, boats bound for Red River and its tributaries, as also those destined for the Atchafalaya, Teche, and all other connecting streams can pass freely through at all high and medium stages. At low water the passage is difficult, and frequently impossible for months at a time, and this condition of affairs has now existed for fully twenty years. Everything indicates that, if left to itself, Old River would soon be closed; nothing but persistent work, repeated year after year, has kept it open so far. The plan upon which the Commission is now engaged does not, to my mind, offer any better chance of a practical and permanent solution than those that have preceded it. Even if the diversion of the low-water discharge of Red River through upper Old River, to the north of Turnbulls Island, can be effected, leaving lower Old River as an inlet to the Atchafalaya, the same difficulties will occur as now, but in two channels instead of one. No assurance can be given that either channel will maintain itself without annual dredging, or that even this can always be made effective. To leave such an important commercial channel subject to the contingencies of annual appropriations is not, in my opinion, an improvement such as is desired by commercial interests, nor contemplated by Congress. Artificial communication by canal between the rivers affected is, in my opinion, the only possible solution of the difficulty. The canal authorized by Congress to connect the Mississippi with Bayou Plaquemine, can undoubtedly be made to furnish all necessary accommodation, even for the Red River commerce; for the Atchafalaya and Teche it will be far better than the present route, whether at high or low stages.

The only other point requiring consideration is the effect on lower Louisiana with regard to the flood discharge of the Mississippi. If the levee system be extended across Old River all the water which reaches the present mouth of Red River must pass between the levees from that point to the Gulf, and the question of interest is whether this condition would be better or worse than with Old River open.

In a paper appended to the present report of the Commission I have set forth at length my views on this subject. I regard the inflow from Red River at high stages as the great factor in disastrous floods in lower Louisiana and that this is true whether the water producing this inflow be crevasse water from the Mississippi or the drainage of the Red River Basin. The Atchafalaya never has acted as an outlet in great floods, and I do not believe that it would do so even if the crevasse water were excluded, as the Red River is invariably in flood at such times. Hence no relief need be expected at high stages, while at all others its influence, like any other outlet, would be decidedly hurtful to the channel. Its entire closure, by concentrating a greater flow past Red River Landing would speedily enlarge the channel and bring down flood heights at that point, to the very great benefit of the country below. If this concentration be made gradually no bad results are likely to ensue. The rapid enlargement and improvement of channel

known to be in progress both above and below Red River Landing, shows conclusively that the river can and will adjust itself to new conditions of increased discharge and without excessive elevation of flood surface, and I am firmly of the opinion that the expected increase of discharge due to the absence of crevasses on the Tensas Front can be more safely and surely provided for with Old River closed than with it open. In fact, I do not consider that any raising of the levees above the grades now aimed at, but not yet attained, would under those conditions be at all necessary.

I think, therefore, that the closing of Old River should be recognized as both desirable and necessary, that the Plaquemine Canal should be pushed to early completion, that the levees below Red River Landing should be put in perfect order and brought up to grade, and that meanwhile the closure of the gap from Bougere down should proceed gradually, so as to throw a constantly increasing increment past Red River Landing, and so enlarge the channel at that point. When all these operations have been completed, then the closure of Old River should be made. Meanwhile, and until the Plaquemine Canal is available, Old River should, if possible, be kept open by dredging, as at present, and ultimately the dam in Red River and the sills in the Atchafalaya should be removed.

Respectfully submitted.

CHAS. R. SUTER,
Lieut. Col. of Engineers, U. S. A.

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APPENDIX I.

PAPER BY LIEUT. COL. CHARLES R. SUTER, CORPS OF ENGINEERS, ON EFFECTS OF RECENT LEVEE CONSTRUCTION, WITH SUGGESTIONS FOR THE RELIEF OF LOWER LOUISIANA FROM EXCESSIVE FLOOD HEIGHTS.

ST. LOUIS, MO., *November 7, 1894.*

GENERAL: The great progress made of late years in levee construction, coupled with the probability that in a few years the system will be substantially completed, has naturally aroused much interest throughout the whole valley of the Lower Mississippi. The increased flood heights due to this artificial restraint, although fully expected and predicted beforehand, have nevertheless created much anxiety among those persons who are personally interested in the matter, and have aroused much apprehension as to what the final outcome will be. This feeling is by no means confined to ignorant persons, professional alarmists and cranks, but affects also so many persons of intelligence and influential position, that some expression of this feeling in the shape of adverse legislation is much to be apprehended. This being the case it seems to me to be the imperative duty of the Commission to prepare for such a contingency beforehand and to avert it if possible by such action or statement of facts as will serve in some measure to relieve the public mind. Although the full measure of results can not perhaps be safely predicted as yet, still the facts now in our possession, or easily obtainable, should enable us to indicate the effects already produced, both good and bad, and the probabilities of the future. As a contribution toward this end I submit the following paper, which, although mainly devoted to the special case of lower Louisiana, still, nevertheless, of necessity, touches more or less on the general features of the problem.

In the early discussion of the levee problem very wide divergencies of opinion are to be noted as to the probable height of floods with a completely restrained river. On the one hand, the assumption of an unchangeable section gave estimates of extraordinary elevations, while on the other an exaggerated opinion of the adjustability of the river bed led to an expectation of depression rather than of elevation. As usual in such cases the truth is now seen to lie between these extremes. The river bed is not fixed, but does adjust itself to new conditions, although this adjustment requires time. Wherever the levees have been carried along basins heretofore open, a considerable elevation of flood heights has been noted, but also a very decided enlargement of section, as evidenced by the depression of the low-water plane. Where levee construction has taken place on both sides of the river, as from the mouth of White River to Vicksburg, both these effects are very marked. As the lowering of the low-water plane is still progressing at a quite rapid rate, while the increase in flood heights is relatively much lower, it seems reasonable to infer that this increase in elevation will soon cease, and may in time be followed by a decline if the enlargement of section continues. In a general way it has been shown that the large increase of flood height has been mainly confined to intermediate points along the great swamp basins; at the lower ends of these basins it has been slight, as for instance at Vicksburg. The only feature of uncertainty which now remains is as to the effect of leveeing the St. Francis Basin. That this will increase flood heights at Memphis, and all points above there, seems certain, but so far as concerns the river below Helena there is this much to be said. All the water which reaches the main stream above the junction of White River now passes Helena between levees and hence has probably produced its maximum effect. There seems little reason for thinking that the height reached in 1886 will be much exceeded by any such floods as heretofore experienced.

As a general proposition it may, I think, be safely asserted that, in the case of rivers like the Mississippi, the bed represents the result of the work expended upon it. Now this work is at its maximum at some period of the flood season, and the most frequent or habitually recurring maximum probably fixes the dimensions of the channel. In the case of very exceptional floods, and generally when they are unrestrained, the effect produced is probably not commensurate with their volume, and may under certain conditions be deleterious rather than beneficial. In the case of an entirely unleveed river the mean height of bank would most likely be the point of maximum effect, and as this bank is artificially raised by levees, so we should look for a corresponding elevation of the point mentioned, a resulting increase of work, and a general enlargement of the channel. That this is true we have positive evidence. The construction of the Upper Yazoo levees has depressed the low-water plane at Helena and Mhoon Landing about 2 feet, the closure of the Upper Tensas basin has depressed the low-water plane between White River and Vicksburg from 2 to 4 feet, and this means enlargement of river section. Reasoning backward from these facts, we should infer that the removal of levee restraint would in time

restore the old conditions. In other words, we may accept as a fact that the river bed is adjusted to meet the most frequently recurring maximum requirements

Below the great swamp basins we find lower Louisiana where, although the conditions are somewhat different, the results have been analagous. Although the river throughout this portion of its course has been more or less completely leveed for nearly a century, yet, owing to its peculiar situation, it has never received the full volume of the river's flow. A considerable portion of this has always escaped through the Atchafalaya country, and of the balance all beyond a certain amount has escaped over the banks and through breaks in the levees between Red River and the Gulf. The channel formed, while of wonderful efficiency, has still only been adjusted to this comparatively small volume and any increase in discharge must involve increase in flood height, at least until readjustment of channel capacity has been attained. That such readjustment is taking place no one can doubt; the evidence given by increased caving of banks is too apparent to be overlooked, but the information obtained at other points by a study of the movement of the low-water plane is not so easily obtained on this portion of the river, although in time it will probably become apparent. Meanwhile the steady increase in flood heights, the higher grades of levees required, the disastrous effects of crevasses which have occurred, and the prospect of all these evils being still further increased as the amount of water coming from above becomes greater, have naturally alarmed the people and raised doubts as to the possibility, not to say the advisability, of placing further reliance on levees alone as a means of protection. As might naturally have been expected, the public mind has at once reverted to the ever-popular theory of outlets, and in some shape or form this is the remedy that apparently now meets with most general favor. To my mind no more suicidal policy could be adopted, and so strongly do I feel the necessity of emphasizing this view that I trust I may be pardoned some further discussion of this rather hackneyed subject. I suppose that no one now doubts that the complete leveeing of the river from Cairo down will in the near future be an accomplished fact, and that volumes of discharge of magnitude never before experienced must be expected and provided for in lower Louisiana. The sole question to be answered is, How can this best be done? Shall it be by complete restraint, or by partial restraint only, or by no restraint at all? It seems to me that the experience of the last forty or fifty years during which the system of partial restraint has been tried most thoroughly should be conclusive on that point. Every great flood on record has deluged and devastated large portions of the State, the loss in direct damages alone amounting to sums that would have paid for a perfect levee system many times over, while the indirect damages to the people and to the general prosperity of the State are beyond computation. If, as has heretofore been the policy of this Commission, the system of complete restraint is to be followed, then it should be done thoroughly and effectively, and should be directed solely with a view to obtain ultimately the best conditions possible. No better way can be devised than to improve the carrying capacity of the channel. This is already good, though, as I have before stated in this paper, it has never had the chance to attain its possible maximum, owing to the habitually small discharge that has reached it. That this question of carrying capacity is the all-important one a moment's reflection should show. A variation in discharge from 200,000 to 1,000,000 cubic feet per second produces an oscillation in gauge height of 30 feet at Red River Landing, and somewhat more at other points higher up the river. At Carrollton the corresponding oscillation is only 15 feet, and at the Forts only 3 or 4 feet. What is the reason for this great difference? Obviously it is the difference in efficiency of section and that alone. Therefore, by increasing this efficiency we provide most surely not only for the floods, which we must expect, but also for those which we may anticipate as possible. No better preparation can be made for the exceptional floods than by passing the habitual ones at as low a level as possible. Such margin of safety as may be given on this portion of the river corresponds to from two to three times the same amount on the portion above. The surest way, in my opinion, to give the greatest possible factor of safety to lower Louisiana is to habitually send down through the channel and under complete restraint the largest possible volume of discharge, so as to increase to the utmost extent the carrying capacity of the channel. That this will be attended with temporary inconveniences I do not doubt, but the ultimate result will be sure and also the best possible. Anything less than a thorough treatment, any dallying with outlet or kindred theories, will mean failure and the infliction of disaster to which those of the past will seem insignificant.

The outlet theory in somewhat modified shape has apparently found some favor of late even among engineers and others who reject the more radical measures which have been from time to time proposed. I allude more particularly to partial outlets or high-water wasteweirs, and to what might be called temporary outlets or artificial crevasses. My own study of the subject has convinced me that an outlet is an outlet under whatever name it be disguised, that the badness of its effects is only a question of degree, and that it is merely a question of time before the full measure

of its evil consequences will be assured. In attempting to form opinions on this subject much time and labor has been devoted to sounding in the vicinity of crevasses to determine what changes in the bottom may have taken place through their influence. The results are reported to be contradictory and generally unsatisfactory. This of itself proves nothing. The deterioration of channel capacity, if such exists, extends over long reaches of the river, and is not likely to be revealed by a few soundings in the immediate neighborhood of a crevasse, even if soundings in depths of water such as are met with in this portion of the river could be entirely depended on. The surface of the water is, however, always accessible and is capable of furnishing us all the information we need.

Slope of water surface indicates resistance to flow, and any change in this slope for equal discharges means variation of resistance to flow between the points compared. If, therefore, we take some one gauge as a standard and establish its relation for equal discharges with other gauges below, we secure a line of reference from which actual variations in the slopes between the various points can be measured, and their meaning interpreted. Discharge remaining the same, a relative diminution of gauge height at any point means increased discharging capacity or efficiency of section at that point, while relative increase of gauge height means decreased efficiency or discharging capacity. Profiles obtained from these relations furnish us standards with which the actual profiles may at any time be compared, thus enabling us to detect any change in regimen over long sections of the river. The manner of constructing these gauge relations has been fully explained in previous papers. I will merely add here that the section of river below Red River Landing is peculiarly favorable to this study, the gauges being numerous and close together, the discharge habitually constant and the various conditions of regimen remarkably stable.

Pl. I shows these gauge relations between Red River Landing-Carrollton, and Red River Landing-Baton Rouge for 1874 and most of the subsequent years to include 1893, from an elevation of 30 feet on the Red River Landing gauge to the maximum heights attained, and is given here mainly to show the effect of crevasses.

In 1874 numerous crevasses occurred, and of these the great breaks at Bonnet Carré and Morganza were left open for many years. We have, therefore, here a perfect example of a partial outlet or high-water wasteweir, as neither of these crevasses discharged water to any great extent below the level of the natural bank. Referring to the plate, it will be noted that the immediate effect of these crevasses was to establish a new line of relation with Red River, which is given by the falling stage observations of 1874. Now, if the theory be correct, that taking off the top of a flood by such high-water wasteweirs can be done without detriment to the channel, then this second gauge relation should have held good during the whole period while these breaks were open, or for the rising stages at least. As a fact we find that such was the case for only a very short time—the measure of relief for different gauge heights being given herewith in tabular form for both Baton Rouge and Carrollton for 1874, 1876, 1880, and 1882. This measure of relief is always estimated from the rising stage of 1874. (See Table I.) Bearing in mind that in 1882 other crevasses occurred to increase the effect of the two large ones at the highest and also for the falling stage, we find that for the rising stage the relief afforded in 1874 of 3.2 and 2.9 feet at Carrollton for stages at Red River Landing of 45 and 35 feet, respectively, had diminished in 1882 to 1.4 and 0.7 feet, respectively. At Baton Rouge the corresponding figures for 1874 are 3.6 and 2.5 feet, for 1882, 1.4 and 0.5 feet. The full series of relations show a progressive change, and that for stages below 40 feet on the Red River Landing gauge the channel had so deteriorated that the relief afforded by these great high-water wasteweirs had practically disappeared, and that even above that stage, at 44 and 45 feet, only about one-third of the original effect remained operative. I can not imagine a more striking object lesson than this, and further comment seems uncalled for.

As regards temporary outlets or artificial crevasses, the great objection, apart from the general question of practicability, is that they would deplete the flow of the river and retard, if not prevent, the increase of channel efficiency which I deem so vitally essential. As a measure of relief they would do no more nor less than crevasses that take place naturally, and with the history of these we are pretty familiar. The table appended gives the lowering due to various large crevasses that have occurred since 1883 at various points below Red River, and their location, as well as that of the various gauges. (See Table II.) From this table it will be seen that the upstream effect of even very large crevasses soon dies out, and that any openings within practicable distances of Lakes Ponchartrain and Borgne—in other words, in the immediate vicinity of New Orleans—would afford very little relief above College Point or Donaldsonville. As to their ultimate effect on the channel, I have no doubt it would be bad, as that of all other crevasses has been.

Referring again to the gauge relations shown on Pl. I, we can, I think, get some further information as to the effects of crevasses on channel efficiency, even when these crevasses are closed as soon as the flood has subsided. It will be noted by com-

paring the standard line common to all the diagrams with the line of actual gauge relations that in all the years of great floods there is a marked deviation in the direction of increased gauge heights at a stage corresponding to 30 feet on the Red River Landing gauge. This is probably due to the resistance offered by the fill-back which we know occurs in passing from high to low water substantially every year and the removal of which requires work. As the river rises to flood stage this effect should and does diminish by scour, but in cases of unusual levee restraint it is supplemented by increased heights due to increase of discharge over that habitually carried. This latter effect would probably become apparent somewhere between 40 and 45 feet on the Red River Landing gauge, the range within which the great crevasses have generally occurred. Should the next year bring another great flood, we should expect the same phenomena to be repeated, but on a lessening scale, due to the enlarged channel capacity resulting from increased levee restraint and measurably proportional thereto. If, however, a large crevassé had occurred near enough to any gauge to materially affect the channel in that vicinity, we should look for its effect in increased gauge readings during the rise of the succeeding year. All these points are very clearly brought out by a study of the floods of 1890, 1891, 1892, and 1893. As an effect of the great discharge in 1890, when the Carrollton gauge stood for some time at the elevation of 16 feet, the highest reading then known, the channel capacity must have been very materially increased, as is shown by the subsequent flood of 1891. The filling up, due to the "Nita" crevasse. probably accounts for the readings from 31 to 35 feet, Red River Landing gauge, which are higher than those of 1890. The Ames crevasse occurred during this flood and was only a couple of miles below the Carrollton gauge. Its deteriorating effect on the channel in that vicinity is very well shown in the flood of 1892, which has markedly high elevations up to about 41 feet on the Red River Landing gauge. That this effect was local is evident by a comparison with Baton Rouge during the same period. The flood of 1891 reached the same height at Carrollton as the flood of 1890; that of 1892 was 1.2 feet higher, and its effect on the channel is well illustrated in 1893, where the divergence from the standard is very much less than before. At about 43 feet on the Red River Landing gauge the effects of increased volume begin to show, the height finally reached at Carrollton being 17.4 feet, at which time the Rescue crevasse checked the rise. There has been no flood since 1893, so that we can not tell what the final result has been, but, so far as the information at our command goes, it shows that a steady improvement in channel capacity and a decrease in all, except extreme flood heights, has followed increased levee restraint, and that the effect of even temporarily open crevasses is, locally at least, extremely bad.

There is, however, another method of reducing flood heights in lower Louisiana, which, to my mind, holds out great promise of success, while at the same time avoiding the evil consequences which I apprehend from such measures as I have already discussed. I allude to the closure of Old River and the complete divorce of the Red River system from the Mississippi. Long study of the subject has convinced me that the gauge height at Red River Landing is the controlling factor in all floods in lower Louisiana. The relations between this gauge and those below, more especially the one at Carrollton, have remained substantially unchanged for over forty years, and seem to establish beyond question that any change in the gauge heights at Red River Landing will be followed by proportional changes below. My opinion, therefore is, that this is the point, and the only one, at which we may obtain substantial relief.

In a previous paper I called attention to the abnormal gauge heights frequently noted at the mouths of tributaries when these latter were discharging into the Mississippi, and also to the fact that these abnormal heights, or as I have designated them, "changes of plane," at the mouth of Red River were out of all reason when compared with the actual measured increments. Further study of the subject has substantially confirmed these views, while I believe it enables me to give a reasonable explanation of this apparent paradox.

I assume that any given discharge entering the head of the delta at Cairo will pass down the stream at such height on the various gauges as the local conditions of regimen may demand, and will occupy such a channel as habitual recurrence of similar conditions has adjusted to its requirements. At some point along its course a body of water of greater or less magnitude is suddenly added to the volume of discharge. What will be the effect? The velocity of the moving water will be checked as by the interposition of any other obstruction and the surface will rise at least to such gauge height as corresponds to the increased discharge now taking place. But will it stop there? I can not think that it will unless we are prepared to concede the possibility of an almost instantaneous readjustment of regimen. On the contrary an abnormal gauge height will result, depending in amount on the extent of the disturbance and the amount of preparation in channel capacity for such a contingency. Now this phenomenon takes place at the mouths of all tributaries, but from the circumstances of the case we should expect a greater effect at those places where

the influx of increment is only occasional than at those where it is habitual. Taking this view of the matter, we may divide the large tributaries below the Ohio into two classes and designate them as habitual and occasional tributaries. To the latter class belong the St. Francis and Yazoo. Their normal discharge is very small, their floods are small and infrequent, and only due to heavy rains over their comparatively small basins. But they are liable to discharge at irregular intervals enormous volumes of water which has reached them by overflow from the Mississippi itself. White and Arkansas, considered as one stream, is, on the contrary, an habitual tributary. While its low-water discharge is small its flood contribution is quite large and recurs with sensible regularity. Finally, Red River has long since ceased to be an habitual tributary and has passed into the occasional class.

I will now proceed to show that the effects mentioned do actually occur in the manner stated. Pl. II gives profiles at the mouth of White River at times when the tributary increment was known, and Pl. III gives similar profiles at Red River Landing. Tables III and IV give the main results in tabular form. Referring to Pl. II, I wish to call attention to the distinct depression in the low-water profile at the mouth of White River and for some distance below. This is undoubtedly due to the habitual effect of the tributary, and shows that the channel below the junction has been substantially enlarged. Nothing of this kind is shown at Red River Landing. Taking the effects of various increments in increasing gauge heights, we see that those at Red River Landing are very much the larger. For instance, at the mouth of White River an increment of 82,000 cubic feet produced a rise of 3 feet, the Helena gauge remaining unchanged at 15.2 feet, while at Red River Landing a change from 13,000 cubic feet outflow to 67,000 cubic feet inflow, or 80,000 cubic feet in all, produced a rise of 5.3 feet, the Vicksburg gauge remaining unchanged at 15.6 feet. The most striking effect, however, is shown in the slopes above Red River Landing. Even these small increments show a distinct backing up to Natchez and St. Joseph, while in the case of White River they are barely perceptible at Sunflower Landing, the next gauge above. At higher stages the same thing is noted. On Pl. II high-water profiles at the mouth of White River for the great-flood years are given. They show no appreciable backing up from the mouth of White River, although the increment there was large—from 400,000 to 600,000 cubic feet per second at least. Pl. III gives high-water profiles for Red River Landing both before and during return flow and for as nearly as possible the same Vicksburg heights. Here we see that the backing-up effect is very marked both at Natchez and St. Joseph. Pl. IV gives similar profiles for the Yazoo and St. Francis; that is, profiles taken before and during return flow. Both show the same feature of extensive backing-up effect, though not to the same extent as at Red River Landing. These illustrations are, I think, sufficient to sustain my idea that the gauge heights reached at the mouths of these occasional tributaries are abnormally high and considerably greater than would be given by the same amount of water flowing down the channel. This question more especially concerns high water, the period when the tributary increment is largest and most destructive in its effects. As far as the Yazoo and St. Francis are concerned, the difficulty can be practically met, and to a certain extent has been met by leveeing in their basins. In the case of Red River this is not possible, for, although the return flow from crevasses might be eliminated, the floods from Red River itself could not, and these are generally of considerable volume and most frequently occur on the very top of the flood at Red River Landing. The complete closure of Old River is the only possible solution of the problem, and to my mind the only proper one.

In all discussion of the complicated situation at the mouth of Red River it seems to have been generally assumed that the Atchafalaya is of the greatest possible value as an outlet during flood stages, and that in fact the salvation of lower Louisiana depends on keeping it open. Now, that the Atchafalaya does carry a large volume of water during high stages of the Mississippi is of course undeniable, but that it is at such times an outlet from the Mississippi is as a rule not true. Certainly, in all recent flood years at least, not a single cubic foot of water has been taken from the Mississippi by this so-called outlet except at low or comparatively unimportant stages. On the contrary, at the time when relief was most urgently needed there has invariably been an immense flow into the Mississippi, and it is this which has given the great flood heights noted at Red River Landing. Pl. V shows the Vicksburg and Red River Landing hydrographs for 1882, 1890, 1891, 1892, and 1893. On this plate the hydrographs for Barbres Landing, at the head of the Atchafalaya, are also shown. They are platted to the same dates as Red River Landing and are reduced to the same zero, so that they give at any time the slope between the gauges. If Barbres gauge is the higher then the slope is toward the Mississippi and the water must be flowing toward that stream; if, on the contrary, Red River Landing is the highest then the slope and flow must be toward the Atchafalaya. Now, in the flood of 1882 the diagram shows that the flow was from the Atchafalaya and into the Mississippi from January 25 to some date after August 20, the crest of the Mississippi flood having occurred on March 27. In other words, this remarkable outlet worked

the wrong way for over six months, including the entire period when it was most desirable that it should afford relief. In 1890 the same thing occurred for over four months, in 1891 for three months, in 1892 and 1893 for over three months. This is certainly a rather poor showing for the efficiency and value of the Atchafalaya as an outlet for the Mississippi. It is of course true that a considerable portion of the high-water flow into the Mississippi at Old River at such times is crevasse water from above, but it must not be forgotten that Red River itself is capable of producing tremendous effects without any assistance of this kind. I myself have seen the banks of Red River deeply submerged from the Landing to the confluence of the Black, including the most of Turnbulls Island, by a flood in Red River alone. There had been no crevasses and the Mississippi was not within 10 feet of the top of its banks. On this occasion the Ouachita was backed up as far as Camden and its banks were deeply submerged. Again, in 1890, long before any crevasse water could have reached Old River, Pl. V shows a strong outflow into the Mississippi, which had already reached a 45-foot stage. This was solely due to a flood in Red River. (See the hydrographs on Pl. VI.) In every case of a great flood in the Mississippi the evidence shows that a flood from Red River has coincided with the maximum gauge heights at Red River Landing and was doubtless largely instrumental in causing them. The baneful effect of this high-stage inflow can hardly be overestimated. Pl. III shows by a comparison of profiles in 1893 before and during inflow, and for the same reading at Vicksburg, that the extra gauge height due to the inflow amounted to nearly 7 feet at Red River Landing. In other words, about that much relief would have been given to the whole of lower Louisiana if Old River had been closed. With such facts before us further argument seems superfluous.

To show this matter still more clearly, however, Pl. IX has been prepared. This plate shows the profile from Vicksburg to Carrollton for a stage at Vicksburg in 1893 within one-tenth of a foot of the maximum and at a time when there was neither inflow nor outflow at Red River Landing (marked No. 1). The profile marked No. 2 gives the corresponding heights for the maximum reading at Red River Landing and profile No. 3 gives the correction necessary to eliminate the effect of the Rescue crevasse, which had occurred three days before. It will be noted that the Vicksburg gauge had meanwhile fallen 3.6 feet from its height on profile No. 1. To allow for this profile No. 4 has been constructed by diminishing the heights on profile No. 1 by amounts equivalent for each gauge to 3.6 feet at Vicksburg.* This should give very closely the profile that would have been found at this time had Old River been closed, and the differences in gauge heights between this and profiles Nos. 2 and 3 should give the maximum effects of the increment from Red River. These values are tabulated on the diagram.

The effectual closure of the Tensas front will probably diminish to some extent the amount of the increment at Red River Landing and will also probably increase the length of the period during which the Atchafalaya may act as an outlet to the Mississippi. But will this be an advantage? To my mind it certainly will not. The evidence already brought forward in the case of the Morganza and Bonnet Carré crevasses justifies the inference that the channel below Red River Landing has already been deteriorated by this outlet and that any increase in its efficiency will lead to still further deterioration. This is certainly not the preparation for great floods which I deem indispensable, and in any case it must not be forgotten that the occurrence of crevasses in the Tensas front is a contingency which can not be absolutely guarded against. Should such occur the deteriorated channel below would give greater gauge heights than even those with which we are now familiar.

If Old River be closed and the Tensas levees held, the whole volume of discharge must pass Red River Landing in the channel, and the question then arises, What height of gauge must be expected for such floods as we are likely to experience? For those of recent years I think a reasonably accurate estimate can be made. On Pl. III a number of profiles marked "normal" have been made for various years. The gauge readings are taken for as high stages as could be found when there was neither outflow nor inflow at Old River, as indicated by the Barbres and Red River Landing gauges. These should therefore show fairly well the true high-water slopes between Vicksburg and Red River Landing for the discharges which caused the respective Vicksburg gauge heights. One of these, in 1893, starts at Vicksburg at an elevation of 48.2 feet, or within a tenth of the highest reading for that year, and the others are for quite high gauge readings. They are sensibly parallel and serve to corroborate the results obtained by the method of gauge relations by which the probable extreme heights herewith given have been deduced. Pl. VII shows the upper portion of the gauge relations for "Mouth of White River-Vicksburg" and "Vicksburg-Red River Landing," together with the lines used in computing the probable heights for 1890, 1891, 1892, and 1893. With regard to these relations there is this much to be said: Those between Vicksburg and Red River Landing are

* See Table VII.

probably entirely reliable, as but little change of regimen could have occurred between these points at the time selected. From White River to Vicksburg the degree of reliability depends on the greater or less amount of possible variation in regimen due to crevasses, and more especially to return flow from the Yazoo. For this reason the relations for 1891, 1892, and 1893 are probably more reliable than that for 1890, and that for 1893 is probably the most reliable of the four. In all these cases the falling stage is necessarily largely conjectural, but is of comparatively small importance. The probable heights of all the four floods both for Red River Landing and Vicksburg, under the condition that all levees had been held and Old River closed, are shown on Pl. V in contrast with the actual elevations. The actual and computed maxima are given for Vicksburg, Red River Landing, and Carrollton in Table VI.

With regard to the probable effects herein noted, it is further to be said that they are believed to be quite on the safe side, as no account is taken of the lowering of the plane of flow which will undoubtedly follow the increase of discharge between Vicksburg and Red River Landing. To form some idea of this probable effect I invite attention to Plate VIII, which shows graphically the effects produced by the increased restraint between mouth of White River and Vicksburg due to the extensive levee building along the upper Tensas. Profiles are given for 1882, 1883, 1890, 1891, 1892, and 1893 for equal heights on mouth of White River gauge, and at two different elevations, viz, 10 and 47.5 feet, this latter elevation being anterior to any levee breaks in the later years designated, while the former is so chosen as to eliminate the local effect of bars, and also to enable more years to be included in the study. Profiles of extreme high and extreme low stages for these years are also given. The noticeable features are the great and progressive lowering of the low-water plane, and the slower rise of the high-water plane, which culminated in 1892 and showed a marked recession in 1893, the year of greatest restraint. It is evident that these results are not yet fully worked out, but they point distinctly to lesser future gauge heights at Vicksburg relatively to the mouth of White River. The same results may be expected to follow at Red River Landing if Old River is closed; that is, the Red River Landing heights should decrease relatively to Vicksburg, and f these latter are decreased relatively to White River a still further reduction at Red River Landing may be expected. This would mean still greater relief for lower Louisiana.

To sum up, it seems probable that the closure of Old River and the complete divorce of the Mississippi from the Red River system would bring about the following advantageous results:

First. The deleterious effect of the Atchafalaya outlet would be done away with.

Second. The floods of Red River would be kept out of the Mississippi, as also the return flow from possible Tensas Basin crevasses.

Third. The extreme flood heights at Red River Landing and all points below would be materially reduced.

Fourth. The increased channel discharge would give increased channel capacity throughout lower Louisiana, with consequent greater factor of safety against occasional floods of unusual magnitude.

Against these advantages and their very great pecuniary value there is only to be set the comparatively small disadvantage of a more circuitous route for Red River commerce, as I take for granted that in such case the Plaquemine or some other artificial route would have to be used. Even this disadvantage, if such it be, would only apply at medium and high stages, for I do not think that there is any great probability of ever establishing reliable low-water navigation through Old River.

Very respectfully, your obedient servant,

CHAS. R. SUTER,
Lieut. Col. of Engineers, Member Mississippi River Commission.

Gen. C. B. COMSTOCK,
Corps of Engineers, United States Army,
President Mississippi River Commission.

TABLE I.

Red River Landing stages.	Equivalent Baton Rouge stages.								Relief from outflow.			
	1874.		1876.		1880.		1882.		1874.	1876.	1880.	1882.
	Rising.	Falling.	Rising.	Falling.	Rising.	Falling.	Rising.	Falling.	Falling.	Rising.	Rising.	Rising.
35	27.0	*24.5	25.9	25.5	26.7	26.9	26.5	26.2	2.5	1.1	0.3	0.5
40	30.6	*28.1	29.6	28.9	30.5	30.3	30.0	30.1	2.5	1.0	0.1	0.6
44	24.1	30.9	32.5	32.3	33.2	33.1	32.8	32.3	3.2	1.6	0.9	1.3
45	35.1	31.5	33.1	33.0	.....	.....	33.7	33.0	3.6	2.0	.....	1.4

Red River Landing stages.	Equivalent Carrollton stages.								Relief from outflow.			
	1874.		1876.		1880.		1882.		1874.	1876.	1880.	1882.
	Rising.	Falling.	Rising.	Falling.	Rising.	Falling.	Rising.	Falling.	Falling.	Rising.	Rising.	Rising.
35	11.9	*9.0	9.9	9.7	11.4	11.1	11.2	10.7	2.9	2.0	0.5	0.7
40	13.2	*10.6	11.3	10.7	13.2	12.9	12.8	12.1	2.6	1.9	0.0	0.4
44	15.1	11.9	11.9	12.0	14.2	14.0	13.9	13.1	3.2	3.2	0.9	1.2
45	15.5	12.3	12.3	12.3	.....	.....	14.1	13.5	3.2	3.2	.....	1.4

*Estimated.

TABLE II.—*Lowering effect of crevasses on gauges below Red River Landing.*

Gauges.	Below Cairo.	1884.* Davis and Morganza.	1890. Nita.	1891. Ames.	1892. Belmont and Sarpy.	1893. Rescue.	Location. Crevasses.	Below Cairo.
	Miles.							*Miles.*
Bayou Sara	799.5	.....	0.2	0.0	0.3	0.3	Morganza	789
Baton Rouge	833.3	1.0	1.4	0.1	1.5	1.0	Rescue	874
Plaquemine	853.5	1.2	1.9	0.4	2.1	1.3	Nita	899
Donaldsonville	885.4	.....	.....	0.9	2.8	1.6	Belmont	908
College Point	903.0	1.9	3.5	1.3	3.3	1.4	Sarpy	937
							Davis	942
Carrollton	957.0	2.0	2.1	1.9	2.5	1.1	Ames	959

*Only approximate effects, as Morganza lowers the standard of reference, Red River Landing gauge.

DISCHARGE OF CREVASSES BETWEEN RED RIVER LANDING AND CARROLLTON, AS OFFICIALLY REPORTED.

Crevasses 1884:
- Morganza 211
- Davis 140
- Other crevasses 74

Total 425

Crevasses 1890:
- Morganza 178
- Nita 402
- Other crevasses 92

Total 672

Crevasses 1891:
- Ames 91

Crevasses 1892:
- Belmont 140
- Sarpy 116
- Other crevasses 39

Total 295

Crevasses 1893:
- Rescue 131

TABLE III.—*Equivalent stages for profiles from Helena to Lake Providence. (See Pl. II.)*

Helena dates.	Helena.	St. Louis Landing.	Mouth White River.	Arkansas City.	Greenville.	Lake Providence.	Increments of discharge.*
Nov 6 1884.....	15 2	22.3	16.7	15.6	14.2	11.6	20
Dec. 22 1884.....	15.2	22.6	19.7	18.3	16.5	13.4	102
Jan 12 1885	33.6	40.0	40.8	38 6	35.0	31.6	283
Jan. 16, 1885.....	36 5	42.3	42.7	40.7	36 7	33.3	309
Mar 22, 1885	33.6	39.1	36.7	34.7	31.3	28.5	60
Feb. 12 1885	26.6	33.9	34.2	32.9	29.6	28.1	199
Nov. 19, 1885	26.4	†33.0	27.4	25 7	23.3	19.4	‡25

Mouth White River dates.§	Helena.	Sunflower.	Mouth White River.	Arkansas City.	Greenville.	Lake Providence.	Increments of discharge.
Feb. 28, 1882.....	45.6	†40.9	48 4	46.7	41.6	38.0	.....
Mar. 31, 1890	47.7	42.9	50.4	48.7	42.8	39.5	.....
Apr. 5, 1891.....	44.3	40.7	47.7	48.2	43.1	40.8	.....
June 1, 1892.....	44.5	41.6	49.3	49.9	44.2	41.8	.....
May 29, 1893	47.5	42.9	49.5	50.1	44.1	39.7	.....

* Between Helena and Arkansas City, from the 1881-85 observed discharges, given in thousands of cubic feet per second.

† Show stages estimated from gauge relations. No readings at that time.

‡ Estimated increment from Arkansas and White rivers.

§ Taken for crest of floods at mouth of White River.

TABLE IV.—*Equivalent stages, for profiles Vicksburg to Baton Rouge. (See Pl. III.)*

Vicksburg dates.	Vicksburg	St. Joseph.	Natchez.	Red River Landing.	Bayou Sara.	Baton Rouge.	Remarks.
Dec. 22, 1884....	14.8	12.1	15.9	15.2	*9.5	10.5	—15
Dec. 24, 1884....	15.7	13.0	16.6	16.1	*10.3	11.0	—13
Dec 29, 1884....	14.5	12.8	17.4	19.4	*13.6	14.0	+63
Dec. 31, 1884....	15.5	14.1	18.9	21.4	*15.4	15.4	+67
Mar. 3, 1885....	24.7	22.7	28.4	31.3	*25.0	24.0	+99
Mar. 5, 1885....	23.0	21.1	26.8	29.8	*23.5	22.8	+97
Nov. 22, 1885...	23.2	*20.5	23.6	21.8	*15.8	15.5	—50
Jan. 23, 1882....	41.3	38.5	40.2	38.4	*31.7	29.0	
Mar. 9, 1890....	46.9	42.6	45.5	43.4	36.8	34.0	
Apr. 29, 1892...	47.0	42.8	45.9	43.2	36.7	34.0	
May 20, 1893...	48.2	44.0	46.7	44.0	37.5	34.6	
June 28, 1892...	47.0	43.8	47.8	48.8	42.1	38.2	
June 24, 1893...	44.6	41.2	46.0	47.7	41.4	37.8	
May 7, 1893.....	44.6	40.4	43.6	40.8	34.2	31.6	

+63 Observed discharges in Old River, in thousands of cubic feet per second. —From the Mississippi. +Toward the Mississippi.

—50 Computed from slope in Old River.

Normal profiles at time of change in Old River from outlet to tributary. No inflow or outflow.

Profiles of high water, showing effects of inflow.

Before inflow.

* Show stages estimated from gauge relations. No readings at that time.

TABLE V.—*Equivalent stages, for profiles, Memphis to Helena and Greenville to Vicksburg. (See Pl. IV.)*

Helena dates.	Memphis.	Mhoons.	Helena.	Vicksburg dates.*	Greenville.	Lake Providence.	Vicksburg.
Mar. 1, 1882.....	34.5	38.0	45.6	Mar. 7, 1882.....	41.3	37.4	44.5
Mar. 9, 1882.....	35.0	39.8	47.2	Mar. 20, 1882.....	41.4	38.3	48.7
Feb. 25, 1884.....	33.9	36.6	43.5	Mar. 11, 1884.....	41.0	38.1	45.8
Mar. 6, 1884.....	34.1	38.9	47.0	Mar. 25, 1884.....	39.7	38.4	49.0
Mar. 15, 1890.....	35.4	36.4	44.2				
Mar. 29, 1890.....	35.3	38.5	47.7				

* Showing contrast before and during return flow.

TABLE VI.—*Actual and deduced maximum stages at Vicksburg, Red River Landing, Carrollton.*

Gauges.	1890.	1891.	1892.	18
Actual high water:				
Vicksburg	49.0	48.1	48.4	
Red River Landing	48.6	45.5	48.8	
Carrollton	16.0	16.0	17.2	
Deduced for levees complete with Old River closed:				
Vicksburg*	50.4	48.4	50.0	
Red River Landing*	46.4	45.5	45.5	
Carrollton†	17.0	16.3	16.4	

* For Vicksburg and Red River Landing, see Pl. V.
† Carrollton taken from Red River Landing stage on gauge relation of the year, see Pl. I.

TABLE VII.—*Equivalent gauge ratios, with time intervals, Cairo to Carrollton.*

Standard gauge of reach.	Ratios equivalent to 1 foot on standard gauge.*		Tim inter fro stand
	Location.	Ratio.	
Cairo	Belmont	0.88	
	New Madrid	.85	
	Cottonwood	.90	
	Fulton	.74	
	Memphis	.82	
	Mhoons	.92	
	Helena	1.04	
Helena	Sunflower	.96	
	Mouth White River	.95	
Mouth White River	Arkansas City	.94	
	Greenville	.87	
	Lake Providence	.80	
	Vicksburg	1.03	
Vicksburg	St. Joseph	.89	
	Natchez	.89	
	Red River Landing	.81	
Red River Landing	Bayou Sara	.96	
	Baton Rouge	.83	
	Plaquemine	.79	
	Donaldsonville	.69	
	College Point	.62	
	Carrollton	.41	

* Equivalent ratios are the normals within banks and are subject to further changes from l effects, etc.

SUPPLEMENT TO PAPER ON "EFFECTS OF RECENT LEVEE CONSTRUCTION," ET

ST. LOUIS, MO., *March 19, 189*

COLONEL: I desire to lay before the Commission certain facts and deductions th from which supplement and emphasize the conclusions set forth in my pape November 7, 1894, which was submitted to the Commission at its last meeting.

In describing the effects of levee construction on channel enlargement, so fa observed, I stated that below Red River this effect while evidently in progr was not yet descernible by the means employed elsewhere, viz, by a compariso low-water profiles. Further examination of the subject shows that at medium st the effect is quite apparent, and that comparative profiles made for these st enable its amount to be estimated. Pl. X gives comparative profiles from River Landing to Carrollton for the years 1881 to 1894 and for various stages in t years. It will be noted that the apparent maximum effect corresponds to abo 23-foot stage at Red River; below a 10-foot stage there is but little apparent cha while above a 30-foot stage the recent profiles are the highest. At Baton Rouge maximum depression occurs, about 3 feet; at Carrollton 2½ feet is the maximum. will also be noted that this depression about equals the superelevation of re high waters, as shown by the profiles of extreme high stages which are given on same plate. At low stages the river surface is so near Gulf level that not m further depression can be expected, and moreover winds and tides have then so g an influence that comparisons between different years are difficult. At the hig stages increased restraint gives higher elevations for recent years, but, neverthel the channel enlargement is evidenced by the comparatively small superelevat

ver Landing stage. At Baton Rouge the change is even greater and more
, and it is also noticeable at Bayou Sara. In other words, the Gulf influence
nding farther up the river, and to higher stages, and this alone is sufficient
f great channel enlargement. A comparison of all the intermediate records
that this change has progressed gradually with levee construction, but has
ost marked in the recent years of great flood restraint.

profiles submitted with my previous paper to illustrate the depression of
urface at points between White River and Vicksburg were of course based
he assumption that at White River there had been no rise. This fact, how-
as been called in question, and, in order to definitely settle this important
I submit Pl. XII, on which profiles are platted from Cairo to Carrollton for
88, and 1893, and also a table (No. VIII) giving similar data for a number of
ears. I have taken in this comparison only such periods, one in each year,
he gauges on the tributaries show that these streams were all quite low.
f the changes alluded to are due to a rise of bed and water surface at White
then the corresponding gauge readings for points above should be lower than
ere before such change occurred. An examination of the plate and table
that for Memphis and all points above to include Cairo, they are higher,
if anything, White River is lower than before. In any case, however, the
ıce is trifling, and I have preferred to assume that no change has occurred
The readings for Mhoons, Helena, and Sunflower are lower, but comparisons
airo and actual measurement at Helena show that these are real depressions
ave followed the construction of levees along the Yazoo and White River

ıese comparisons I have chosen an elevation of 10 feet at the mouth of White
for reasons given in my previous paper, the most important one being to avoid
fluence of the bars at very low stages. The profile shows that, even at the
:hosen, their effect is not entirely eliminated, the high recent readings at New
l being caused by the great bar at Harris, near Point Pleasant. (See Plate

profiles on Pl. XII show with much clearness the great changes in the river
at have followed levee construction. Below Vicksburg the Waterproof Cut-
ıbably accounts for some of the depression shown at St. Joseph, but this same
ıce should have raised Natchez. As a lowering is, however, apparent at that
although less in amount than above, it is evident that channel enlargement
ken place there also, although Natchez is too much under the influence of Red
for much change to be expected. Red River Landing apparently, like the
of White River, is substantially unchanged. I have continued the profiles to
lton as a matter of general interest, although the stage is too low to show
ıl changes, as elsewhere explained in this paper.

curious irregularities in the 1893 profile below Red River Landing are
ıted for by a storm then prevailing, according to a note on the published
record.

ill be noticed that at the mouths of the St. Francis and Yazoo great depres-

from Old River, would give lower Louisiana a security which it never has experienced, and probably can never hope to experience in any other way.

Very respectfully, your obedient servant,

CHAS. R. SUTER,
Lieut. Col. of Engineers, Member Mississippi River Commission.

Lieut. Col. GEO. L. GILLESPIE,
Corps of Engineers, United States Army,
President Mississippi River Commission.

TABLE VIII.—*Stages equivalent to the nearest 10-foot reading on the mouth White River gauge during the fall low-water periods of the tributaries.*

Mouth White River dates.	Time intervals.	Gauge reading Dec. 22, 1882.	Gauge reading Sept. 16, 1883.	Gauge reading Sept. 24, 1884.	Gauge reading Oct. 24, 1895.	Gauge reading Oct. 12, 1888.	Gauge reading Sept. 27, 1891.	Gauge reading Oct. 5, 1892.	Gauge reading Sept. 25, 1893.	Gauge reading Aug. 13, 1894.
Mississippi River:										
Cairo	—4.6	7.7	7.5	7.4	8.4	7.4	6.4	6.8	8.2	8.4
Belmont	—4.5	.....	7.9	8.1	8.0	7.3	6.4	6.5	7.5	7.0
New Madrid	—4.0	4.0	4.5	5.5	5.5	5.2	5.9	6.2	6.8	6.2
Cottonwood	—3.3	3.8	4.1	4.1	.....	.....	3.5	3.5	4.4	5.0
Fulton	—2.9	6.8	6.9	6.6	6.3	6.8	6.2	7.3	7.4	6.3
Memphis	—2.3	3.8	4.2	4.5	4.2	5.7	4.5	4.5	4.6	3.7
Mhoons	—1.6	6.3	5.5	3.9	.....	.....	2.7	2.1	1.1	.4
Helena	—1.1	8.8	9.5	8.8	8.0	6.6	6.0	5.6	5.6	5.8
Sunflower	— .6	7.7	8.4	*8.0	.....	.....	6.9	6.7	7.0	6.9
Mouth White River	0.0	9.9	10.1	10.0	10.0	10.0	10.0	10.0	.10.0	10.1
Arkansas City	+0.5	7.7	7.6	7.6	7.7	7.4	5.9	6.0	5.6	5.8
Greenville	+0.8	7.4	8.3	8.2	8.3	7.1	6.5	5.7	5.1	5.5
Lake Providence	+1.7	6.1	7.0	6.0	6.4	7.2	4.5	3.6	2.7	2.5
Vicksburg	+2.5	†7.8	6.3	5.5	4.9	5.1	3.9	3.2	2.7	3.9
St. Joseph	+3.2	†8.0	6.6	6.5	.....	.....	1.3	1.9	.6	.6
Natchez	+3.8	†11.0	8.1	8.0	6.7	7.8	8.3	8.0	7.0	7.5
Red River Landing	+4.7	†11.1	6.4	6.4	7.4	6.0	4.8	5.4	5.9	4.7
Tributaries:										
Little Rock	—2.0	4.2	5.5	5.8	5.1	3.7	4.7	7.4	4.5	4.5
Clarendon	—1.0	‡4.8	‡2.5	6.8	6.2	6.2	6.5	7.2	6.8	8.8
Alexandria	§+3.0	§20.6	§—1.0	§—1.4	§—1.8	§— .7	§ .6	§ .8	§—1.0	§ .6

* Deduced from St. Louis Landing.
† See Alexandria gauge. Increment from lower tributaries.
‡ Jacksonport gauge.
§ Minus three-day intervals.

TABLE IX.—*Dates and stages at Red River Landing of the beginning and end of periods of high stage inflow from Old River, as given by the fall between Barbres and Red River Landing gauges; also dates and stages of high waters and the period of inflow before and after the crest of each flood at Red River Landing.*

Year.	Inflow begins.		High water.		Inflow ends.		Periods of inflow days.		
	Date.	Stage.	Date.	Stage.	Date.	Stage.	Beginning to high water.	High water to end.	Total period.
1881	Mar. 18	39.3	Apr. 7	40.1	May 3	39.0	20	26	46
1881	May 24	39.3	June 4	39.6	July 20	23.4	11	46	57
1882	Jan. 25	38.3	Mar. 27	48.5	Aug. 24	23.3	61	150	211
1883	Feb. 20	35.4	Apr. 9	45.2	July 1	38.4	48	82	130
1884	Feb. 19	38.2	Mar. 30	47.3	July 9	32.4	40	101	141
1885	Jan. 24*	41.0	Feb. 5	42.0	Mar. 18	31.3	12	41	53
1886	May 25	41.7	May 31	41.9	July 8	32.2	6	38	44
1887	Mar. 29	42.0	Apr. 8	43.0	June 11	20.2	10	64	74
1888	May 5	40.8	Apr. 30	41.7	June 15	33.7	†—5	46	41
1889	Feb. 2	33.1	Feb. 12	33.6	Mar. 4	30.3	10	20	30
1890	Mar. 12	43.6	Apr. 23	48.6	July 14	25.6	42	82	124
1891	Mar. 14	44.1	Apr. 30	45.5	June 19	25.2	47	50	97
1892	May 2	43.4	June 28	48.8	Sept. 13	9.9	57	77	134
1893	May 24	44.3	June 26	47.7	Sept. 13	4.4	33	79	112
1894	Apr. 6	39.5	Apr. 6	39.5	June 10	27.8	0	65	65

* See Old River discharges.
† Inflow begins after high water at Red River Landing.

PLATES.

I. Gauge relations, Red River Landing-Baton Rouge and Red River Landing-Carrollton.
II. Profiles, Helena to Lake Providence, showing increment effects.
III. Profiles, Vicksburg to Baton Rouge, showing increment effects.
IV. Profiles, Greenville to Vicksburg and Memphis to Helena, showing increment effects.
V. Flood hydrographs, Vicksburg, Red River Landing, and Barbres Landing, with deduced stages.
VI. Red River hydrographs at Alexandria.
VII. Gauge relations, Mouth White River-Vicksburg and Vicksburg-Red River Landing.
VIII. Levee effects, Mouth White River to Vicksburg.
IX. Profiles, Vicksburg to Carrollton, 1893, showing effects of high-water inflow at Red River Landing.
X. Levee effects, Red River Landing to Carrollton, shown in contrasting profiles, 1881–1894.
XI. Gauge relations, Red River Landing-Carrollton and Red River Landing-Baton Rouge, 1881–82 and 1893–94.
XII. Comparative low-water profiles, Cairo to Carrollton, 1883, 1888, 1893.
XIII. Gauge relations, Cairo-New Madrid, fall of 1883 and 1893, showing low-water effect at New Madrid of Harris Bar, near Point Pleasant.

TABULATIONS.

I. Equivalent Baton Rouge and Carrollton stages, with relief from outflow, 1874 to 1882.
II. Lowering from crevasses, 1884, and 1890 to 1893.
III. Equivalent stages for profiles, Helena to Lake Providence (see Plate II).
IV. Equivalent stages for profiles, Vicksburg to Baton Rouge (see Plate III).
V. Equivalent stages, Memphis to Helena and Greenville to Vicksburg (see plate IV).
VI. Actual and deduced maximum stages, Vicksburg, Red River Landing, and Carrollton.
VII. Equivalent gauge ratios, with time intervals, Cairo to Carrollton.
VIII. Stages equivalent to the nearest 10-foot reading on the Mouth White River gauge during the fall low-water periods of the tributaries.
IX. Dates and stages at Red River Landing of the beginning and end of periods of high-stage inflow from Old River, as given by the fall between Barbres and Red River Landing gauges; also dates and stages of high waters and the period of inflow before and after the crest of each flood at Red River Landing.

APPENDIX 2.

PAPER BY CAPT. C. McD. TOWNSEND, CORPS OF ENGINEERS, ON THE INFLUENCE OF THE BASINS OF THE MISSISSIPPI RIVER ON ITS FLOOD HEIGHTS.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., February 21, 1895.

COLONEL: I have been investigating the subject of the effects of recent levee construction upon flood heights, and, though starting with the same data employed by Colonel Suter in a paper read by him at the last meeting of the Commission, my conclusions differ from his materially.

This question is worthy of most serious consideration by the members of the Commission, for if the deduction that the further extension of the levees of the Lower Tensas levee district will lower flood heights at the head of the Atchafalaya Basin over 3 feet is correct, there should be a readjustment of levee allotments; the recent transfer of $100,000 from the Lower to the Middle Tensas district is a serious mistake, and the allotments for the Atchafalaya district should be transferred to the Lower Tensas district.

The general proposition, however, that while levee construction has heretofore usually raised flood heights, its further extension will lower them at a particular locality, merits very careful analysis before acceptance. It is paradoxical, to say the least. I therefore submit the following upon the influence of the basins of the Mississippi River on its flood heights:

There accompanies this paper blue prints of the hydrographs of the crests of floods at Cairo, Helena, the mouth of White River, Vicksburg, and the mouth of Red River, for the years 1882, 1883, 1884, 1886, 1890, 1891, 1892, and 1893. During all these floods

the St. Francis Basin has been unprotected. In 1882, 1883, and 1884 the levees of the Yazoo Basin offered slight resistance to overflow. But they have been gradually strengthened until in 1892 and 1893 they prevented any inflow into that basin above Eagle Lake, the end of the levee system. While the levees of the Tensas Basin have also been strengthened, they have broken during every flood. The dates of the various crevasses that have occurred in the third district since 1890 are also shown on the hydrographs.

In discussing these hydrographs I shall make use of Table VII of Colonel Suter's paper, which contains what is termed "equivalent" or normal gauge ratios from Cairo to Carrollton. I shall substitute in this paper the term "mean" for "equivalent." Equivalent or normal gauge ratios assumes that a definite relation exists between gauge and discharge. In a paper printed in the Report of the Commission for 1891, page 3417, is explained the difficulty experienced in graphically expressing by a simple curve the relation between the discharge and gauge. The reason that such was the case is simply that discharge for the same gauge height varies considerably from time to time. If equal discharges accompany equal gauge heights, the conditions accompanying the discharges must be the same.

From a pipe constant discharges are obtained for the same head, because not only the cross-section always contains the same area, but the filaments of water must always follow the same lines. If the interior of the pipe be roughened or the head reduced the discharge of the pipe will vary.

Similarly in a river, for equal discharges for the same gauge heights, not only must the area of the section remain constant, but the areas of section for long distances above and below it must remain unchanged, so that there will be the same resistance to flow in the two cases. It is also necessary that the force which produces the discharge shall create the same velocities.

In a river flowing through an alluvial bed, none of these conditions ever exist; the areas of cross-section are continually varying; the resistance to flow constantly changes, and no two floods rise at the same rate and in the same manner.

The following discharges, derived from the mean of three consecutive observations, afford excellent illustrations of this point:

Wilsons Point.—Lake Providence gauge reading, 41 feet.

Date.	Discharge.	Mean velocity.	Area below datum.
1890	1,220,000	5.8	190,000
1891	1,223,000	5.4	211,000
1892	1,350,000	6.0	215,000
1893	1,390,000	6.1	227,000

Arkansas City gauge reading, 48 feet.

Date.	Discharge.	Mean velocity.	Area below datum.
1890	*1,185,000	5.7	184,000
1891	1,417,000	5.9	216,000
1892	1,563,000	6.6	225,000
1893	1,314,000	5.3	253,000

* One observation.

At Wilsons Point the increased discharge for the same gauge heights has been principally due to the increased area of cross-section. At Arkansas City the area increases and discharge increases until 1893, when, due to diminished velocity, the discharge decreases.

The diminution in discharge at Helena in recent years for the same height is not due to any increased resistance to flow, nor diminution of sectional area, but to the fact that there has been more water in the lower river to be driven to the Gulf, and less force at Cairo, due to less flood heights to do the work. There has been a loss of velocity.

As an illustration of extreme variations in discharge, I note on Pl. XVI of Humphreys and Abbot's report on the Mississippi River, discharges varying in one season from 740,000 cubic feet per second to 1,180,000, at 31 feet on the Columbus gauge.

A corollary from the foregoing results that equal discharge or equal gauge heights at a given station will not produce equal gauge heights at a lower station on the

river unless the areas of section remain constant between the two stations, and there is no change in the resistance to flow, nor in the force that is driving the water down the river—an almost physical impossibility in a silt-bearing stream.

Numerous examples of variations in gauge heights caused by inflow of tributaries are cited by Colonel Suter. In a paper on Gauge Relations, which is contained in the Report of the Commission for 1894, I endeavored to show that these variations may arise from other causes.

Between Cairo and Helena there has been a reduction in gauge heights in recent years, caused by the gradual enlargement of cross-section in the vicinity of Helena, but neither enlargement of cross-section nor inflow of tributaries will account for all the variations in gauge heights that are shown in the tables accompanying that paper. I will illustrate by a few examples:

On June 22, 1885, the crest of a rise passed Cairo with a gauge height of 30.8 feet; when the crest passed Helena it had a height of 33.2 feet. On January 11, 1886, the crest of a rise at Cairo was 30.2 feet; when it passed Helena the gauge stood at 29.9 feet. The Wittsburg gauge, on the St. Francis River, on the two dates read 2.95 and 3.13. December 22, 1885, the Cairo gauge reads 24.7; for the same crest, the reading at Helena is 23.7. On June 27, 1891, the Cairo gauge reads 25.5; the corresponding reading at Helena is 26.9. The readings of the Wittsburg gauge are 0.13 and 1.20.

In all these cases the St. Francis River is very low and has been so for some time. These variations of 2½ feet in gauge height can not arise from that source.

It is evident that the river has been enlarging its cross-section so that the increased height of 1891 can not arise from increased resistance to flow. If we examine the main river, however, there is found in the cases where the reading at Helena is below that at Cairo, that the rate of rise at Cairo has been much more rapid than in the other two cases. The propelling force has changed, causing a variation in velocities.

While these gauge ratios are constantly changing, the mean values approximate those given in Table VII. Between Helena and the mouth of White River, and Vicksburg and the mouth of Red River, a cursory examination of the crests of rises would indicate that the mean of gauge ratios was considerably larger than the equivalent ratios contained in the table, which I assume is due to the fact that in the tables the effect of the inflow of the tributary has been eliminated.

But, howsoever these gauge ratios may be derived, for any particular case they are *only* approximate values; they are the gauge ratios plus important corrections.

Examining the blue prints of hydrographs submitted, it is evident to the eye that the relation between the Cairo hydrograph and those below it has changed since 1886. In 1882, 1883, 1884, and 1886, the crest of the Cairo hydrograph is from 3 to 4 feet above that of any of the others, but from 1890 to 1893 the hydrographs attain more nearly the same height; the crest of the flood at the mouth of White River invariably exceeds that at Cairo. It is to be noted, however, that since 1890 the floods at Cairo have not attained the height that obtained from 1882 to 1886, but it will have to be admitted, either, that if floods at Cairo like those of 1882, 1883, 1884, and 1886, are precipitated upon the lower river under conditions similar to those that have existed since 1890, there will be increased flood heights below, or that the effect of the St. Francis Basin has been to bring floods of from 49 to 52 feet at Cairo to a height of between 47 and 48 feet at Helena.

Comparing the hydrographs of Cairo and Helena, it is to be noted that while a gauge ratio of 1.04 may approximately exist up to a stage of 40 feet, above that stage for the first ten days there is an abrupt falling off in the Helena gauge, and notwithstanding the variations in height of the Cairo gauge in different years, the Helena gauge stands about 44 feet.

It is self-evident that up to this period the influence of the St. Francis Basin has been to lower flood heights. But from ten to fifteen days after a rise at Cairo, there is to be noted a rapid rise at Helena, which in 1882, 1883, and 1884 attains a height of about 47 feet, and in 1886, 1890, and 1893 of about 48 feet. This is caused by the superposition of the water which has escaped into the basin during the earlier stages of the flood upon the 44-foot rise coming down the main river from Cairo.

Now if the basins between Cairo and Helena are protected from overflow by levees sufficiently close to the river banks, the gauge ratio that is observed below the overflow stage will be extended to the extreme flood stage; not only would the rise in plane which is noted when the return wave enters the river cease to exist, but the fall in plane in the earlier stages of the overflow would not occur. If a gauge ratio of 1.04 should exist between Cairo and Helena above the overflow stage, it would mean that the hydrograph at Cairo would be repeated at Helena three and one-half days afterward with a slight increase in height, and that the crests of the floods of 1882, 1883, 1884, and 1886 would have passed Helena at an elevation of between 51 and 52 feet.

If the cases cited by Colonel Suter in Table V of his paper are investigated, it will be seen that on March 1, 1882, February 25, 1884, and March 15, 1890, the height of the flood at Cairo is at its maximum, while at Helena the overflow into the St. Francis Basin has produced its maximum effect in reducing flood heights. On March 9, 1882, March 6, 1884, and March 29, 1890, there has been a marked fall at Cairo, and the outflow from the St. Francis bottom has produced its maximum effect upon the gauge at Helena.

That the mean gauge ratios below the overflow stage do not obtain in either set of cases is not at all surprising. These ratios were established under the assumption that the St. Francis Basin was exerting no influence on the discharge. The examples cited are at periods when its influence is at a maximum or a minimum. It is not necessary to assume that the inflow of a tributary reduces velocities; that damming a river raises flood heights below the dam. There have been most violent changes in the river slopes which sufficiently account for the variations observed.

It may be admitted that on March 9, 1882, March 6, 1884, and March 29, 1890, the river stood higher at Helena than it would have stood on those dates if the basin had been leveed. This has nothing to do with the problem. The true question to be determined is whether with a leveed river the heights which would have been attained at Helena on March 4, 1882, February 29, 1884, and March 19, 1890, would have exceeded them or not.

In a former paper I have shown that since 1872, the earliest records I have, there has never been any combination of conditions that has raised the crest of the return wave at Helena to such a height as the crest of the Cairo flood would have produced if the mean gauge ratio between the two places had been extended above the overflow stage.

Comparing the hydrographs of Helena and the mouth of White River, it is to be noted that while in 1882, 1883, 1884, and 1886 the crests of flood waves have been within 1 foot of the same reading, in 1890, 1891, 1892, and 1893 the crest of the flood at the mouth of White River markedly exceeds that at Helena.

The gauge ratio above the overflow stage has been increasing in recent years. Whether the channel of the river has been enlarging or not, the relative heights of floods have been increasing.

In the paper on gauge relations I showed that the same tendency is to be observed in the crests of rises below the overflow stage, and submitted the following deduction: That the increased discharges we are having in recent years from the White and Arkansas rivers have more than compensated for any increase in discharging capacity that has resulted from enlargement of the river section.

Examining the Vicksburg hydrographs it is seen that in 1882, 1883, 1884, and 1886 the floods propagated down the channel have been able to maintain a height of from 43 to 45 feet on the Vicksburg gauge without any return wave; that in 1883 and 1886 the return flow coincided with a low stage of the main river transmitted from Cairo, and we have the maximum reduction in flood heights at Vicksburg that the St. Francis and Yazoo basins are capable of producing. In 1882 and 1884 the return flow is impressed upon a high stage in the main river, and we have a minimum reduction in flood heights due to unleveed basins, the gauge at Vicksburg attaining a height of about 49 feet both years.

When the hydrographs of later years are examined a marked change is to be noted; from 1890 to 1893 the river shows a tendency to attain a height of 48 feet without any return flow from the Yazoo; in 1890, after extensive crevasses occurred, the height of 48 feet could not be maintained, the river falls at Vicksburg to 46.5 feet and the return flow then raises the river to 49 feet.

In 1891 the effect of the return flow is not appreciable; in 1892 and 1893 we know there was no return flow, as there were no breaks in the levees. Another point to be noted is that the hydrographs at Vicksburg for flood stages in latter years are bearing a closer resemblance to those at the mouth of White River, and, notwithstanding the fact that at high stages an increase in gauge ratios has been found between Helena and the mouth of White River, a still further increase is to be noted between White River and Vicksburg until crevasses occur in the levees in the third district. In 1891 and 1892 the increased rise of the Vicksburg gauge is apparent to the eye by its hydrograph crossing that of the mouth of White River before the highest stage at the latter locality is attained. In 1893 it is equally apparent from the fact that the rate of rise at Vicksburg previous to the first crevasse largely exceeds that at the mouth of White River.

At the mouth of Red River the hydrographs indicate that the effects of the various basins have been to change the irregular curves that are found above into a long low swell. The form of the Cairo hydrograph has been completely lost.

Measurements or estimates of the discharges through the various crevasses have been made for most of the years in which hydrographs of the flood waves are submitted, and can be found in various reports of the Mississippi River Commission.

The sums of the maximum discharges of the various years in the Yazoo and the Tensas basins above Vicksburg are as follows:

Basin discharge.	1882.	1883.	1884.	1890.	1891.	1892.	1893.
Yazoo	781,000	546,000	598,000	454,000	50,000	.....	.....
Tensas above Vicksburg	450,000	187,000	384,000	412,000	105,000	524,000	607,000

These furnish a method of further analyzing the effect of the return of the flood wave at Vicksburg. Anyone, however, who has seen a crevasse will appreciate that such measurements will not be taken with the greatest accuracy. The observer's mind is too much occupied in the problem of preserving his own life to pay close attention to the nice details which are necessary to obtain an accurate discharge. I therefore prefer, instead of the designation "cubic feet per second," the representation by a variable symbol, x, of the discharge into the Yazoo Basin, and by y of discharges into the Tensas Basin. Discharges in the river proper have also been taken; I shall represent such discharges as so many "z's."

In 1882, 1,050,000 is the maximum number of z's that pass Lake Providence, and they raise the water at Vicksburg to 44¼ feet. When on these z's 780,000 x's are precipitated the Vicksburg gauge records 48.75 feet.

In 1884, 1,060,000 z's are propagated down the river at a stage of 45 feet, and when the 600,000 x's flow out on this discharge the gauge records 49 feet.

In 1890 we have 1,200,000 z's maintaining the river at 46.5 feet on the Vicksburg gauge, which is increased to 49 feet when the effect of 450,000 x's is experienced. In 1892 and 1893, 1,350,000 and 1,450,000 z's, respectively, raise the Vicksburg gauge to over 48 feet, with no x's to affect the flow.

In other words, the increase from 1882 and 1884 to 1892 and 1893 of about 400,000 z's in the river channel has raised flood heights at Vicksburg from 44¼ feet to over 48 feet, while in 1882 and 1884 the 750,000 and 600,000 x's abstracted from the river above raised the height of the Vicksburg gauge from 44¼ feet to about 49 feet, when they returned to it. If $z = x$ there is a loss of energy when water escapes into a basin. If, however, z produces the effect of $2x$, which is not improbable, as the waters which escape from the various crevasses will not arrive at Vicksburg at the same time, it makes little difference in the height attained by a gauge whether the water that flows by it comes down the channel or across the country.

It is to be noted that while the x's in recent years have been diminishing, the y's have been correspondingly increasing, so that in 1893 there was flowing from the crevasses in the Tensas Basin above Vicksburg 600,000 y's, the amount of x's that escaped into the Yazoo Basin in 1884. When the Tensas Levee system is completed the y's must pass Vicksburg in the river channel, giving increased flood heights.

Colonel Suter estimates an increase in flood height at Vicksburg, in Table VI, due to levees, but I consider his figures too small. His process of determining the height of the Vicksburg gauge will be found in Pl. VII, accompanying his paper, where platted lines of gauge relations which appear in the blue print as curves are extended as straight lines. By extending these straight lines backward and comparing them with the observed curve, it is evident that errors are being introduced.

To illustrate to what errors this process of reasoning might lead it is only necessary to select the particular cases in 1890, when the White River gauge read about 46¼ feet, and in 1891, when it read about 45¼ feet. If these elements of the curve were extended as right lines, heights at Vicksburg of over 100 feet would result from leveeing the river.

These same gauge relations platted on Pl. VII, if the premises are true, show the reverse of what is claimed—that there has been an increased resistance to flow at Vicksburg in recent years. Thus, take 35 feet on the White River gauge: In 1890 the gauge relation gives 31 feet at Vicksburg; in 1891, from 32 to 33 feet; in 1892, 33 feet; in 1893, 33¼ feet. Forty-five feet on the White River gauge gives 41 feet at Vicksburg in 1890, 44 feet in 1891, 44 feet in 1892, 43.2 feet in 1893.

These gauge relations show the same thing as the hydrographs from which they are derived, viz, that the tendency of levees has been to increase gauge heights at Vicksburg above the overflow stage until a crevasse occurs.

But a more serious error arises from the assumption that the gauge heights at the mouth of White River would not be affected by the completion of the levees in the Tensas Basin.

In 1890 the discharge around the head of the levee system at Amos Bayou was 50,000 cubic feet per second, and the maximum discharge of the crevasses in the Cypress Creek line was 80,000 cubic feet per second. In 1892 the discharge around the head of the system was 300,000 cubic feet per second; in 1893, 100,000 cubic feet, and the Sains Crevasse on Cypress Creek discharged about 100,000 cubic feet per

second. This water did not affect the White River gauge, but flowed directly fro the Arkansas River behind the levee system.

The reason why the flow of the floods of the White and Arkansas rivers appea to produce little effect at the mouth of White River is on account of this enormo waste weir at the head of the Tensas Basin. When the Mississippi River attains height of 49 feet on the White River gauge it is easier for one-half of the 400,000 600,000 cubic feet per second that are poured out by the White and Arkansas rive to flow across the country than to force their way between levees, but when t Mississippi River is below bank-full stage, as it was in 1894, the combined floods the White, Arkansas, and St. Francis rivers can raise it from 10 to 12 feet.

There are the same objections to the examples cited in Table V for Vicksburg in those for Helena. While it is indisputable that on March 20, 1882, and March 2 1884, the heights attained at Vicksburg would have been less if the levees had hel it is equally as evident that on March 7, 1882, and March 11, 1884, they would ha been very much larger than they were. The same is true of the process of reaso ing at the mouth of Red River.

The deduced maximum stages at Red River Landing, contained in Table VI, a affected by three errors: First, the assumption that the gauge at the mouth White River will not be affected by the completion of the Tensas levees; second, improper extension of the curve of gauge relations found to exist between t mouth of White River and Vicksburg; and, third, in the assumption that the slo between Vicksburg and the mouth of Red River with levees completed will be t same as now exists when the crevasses are discharging a maximum into the Tens Basin.

That slope is a most important item in gauge heights can be shown not only l the examples above quoted, but by the following at the mouth of Red River:

On July 21, 1873, the Vicksburg gauge stands 31.2. When the crest of the ri reaches the mouth of Red River the gauge attains a height of 31.4 feet, the corr sponding reading of the Alexandria gauge being 17.9. On January 10, 1878, t Vicksburg gauge reads 33, the crest of the wave passes the mouth of Red River 26.4, the Alexandria gauge reading 20 feet. On January 21, 1891, Vicksburg gau reads 33.6 feet, the corresponding readings of the Red River and Alexandria gaug being 32.6 and 16.8, respectively. Here are variations as great as can be shown du ing high water, and it is perfectly evident that levees, the stage of the Red River, the enlargement of section have nothing to do with them, without it is assumed th levee construction from 1878 to 1891 has enormously reduced the cross-sectional are or that the higher the water at Alexandria the less its influence on the Mississipp

Slope is primarily a measure of the force that is driving the water down the riv not of resistance. If employed to measure resistance, the less the resistance t less is the slope.

The channel formed from the Red River to the Gulf is of wonderful efficienc In that portion of the river the slope is the least. If the velocity remains the sa in any cross section, any diminution of slope must be accompanied by increase hydraulic mean depth or diminution of resistance to flow. If the same heights a attained on a gauge with different river slopes, the natural assumption would that the discharge varies, not that the discharge remains the same, and that th has been a change in resistance to flow.

If it be admitted that the tendency of leveeing the river is to extend gauge rat from the overflow stage to the crest of the flood, there is no necessity of discussi for some years the ultimate effect of levees on the lower Louisiana flood heights. levees are built close enough to the river bank to produce such results, before th gauge ratios are propagated from Cairo to Vicksburg the levees of the third distr will be overtopped by any floods like those of 1882, 1883, 1884, and 1886. The Ya and Tensas basins will again exert their modifying influence upon flood heights.

The influence of enlargement of cross sections as a result of confining the ri will now be considered. The effect of such enlargement will be to change the gau ratio below the overflow stage. This effect is overestimated in the paper. T method of determining the results is given on Pl. VIII. The profiles of equival stages shown on that plate rest on the assumption that there has been no change plane at the mouth of White River. If the gauge at Vicksburg had been assumed constant, instead of that at the mouth of White River, these same profiles wo indicate that there had been a rise of plane at the mouth of White River. The tr lies between the two assumptions: These changes have been due to both a loweri of the plane at Vicksburg and rise in plane at the mouth of White River.

To my paper on "Gauge relations" there is appended a table of low-water readi from 1872 to 1892 at Cairo, Helena, mouth of White River, Lake Providence, a Vicksburg. That table shows that while low-water readings in recent years Helena and Vicksburg have been becoming relatively lower, they have been bec ing just as markedly higher at the mouth of White River. While Lake Provide gauge from 1886 to 1890 was also showing increased heights with reference to Cai and corresponding with White River, since 1890 its stage has more closely resemb

that at Vicksburg. In Table III of the same paper was given a comparison of gauge readings at Cairo, Helena, mouth of White River, and Vicksburg, for crests of rises 15, 20, 25, 30, and 35 feet on the Cairo gauge.

I give in tabulated form the mean of these readings from 1872 to 1882, and from 1883 to 1892:

Locality.	15-foot rise.		20-foot rise.		25-foot rise.		30-foot rise.		35-foot rise.	
	1872–82.	1883–92.	1872–82.	1883–92.	1872–82.	1883–92.	1872–82.	1883–92.	1872–82.	1883–92.
Cairo	15.0	15.0	20.0	20.0	25.0	25.0	30.0	30.0	35.0	35.0
Helena	15.0	14.0	21.1	19.9	26.5	25.7	31.5	30.4	36.9	35.6
Mouth of White River	14.5	16.0	22.4	22.8	28.5	29.3	33.7	33.5	40.7	38.9
Vicksburg	12.1	11.5	20.7	18.8	27.4	26.3	31.8	30.7	38.3	36.3

The observations for some of these stages are too few to afford a good average. These means, however, tend to confirm what is shown by the table of low waters, that something in recent years has been filling in the low-water channel in the vicinity of the mouth of White River. It may be sand, or it may be an increased discharge from the White and Arkansas rivers.

The results shown in the tables could also have been caused if the floods in the vicinity of the mouth of White River had attacked the banks with more energy than they did the bottom, widening the river and precipitating more earth in the channel than they were capable of carrying away. This theory is somewhat confirmed by the peculiar action of the low-water gauge at Lake Providence. During the years that this gauge corresponds with the White River gauge, a mean of the sections of the annual soundings in low water through Lake Providence Reach indicated that the river was widening its section and diminishing its low-water depth. During the last three years this shoaling has ceased, and the tendency of the river has been to deepen its low-water channel. During these years this gauge has been regaining its relation to the Vicksburg gauge.

I also consider it probable that the deepening effect noted at Lake Providence is extending upward toward the mouth of White River, and that the ultimate effect of levee construction will be to lower the plane at that locality, as it has at the other places given in the tables; but such action is not yet perceptible at the mouth of White River.

If the same method of reasoning were applied between Helena and the mouth of White River, instead of between the mouth of White River and Vicksburg, it would show the reverse of what it was attemped to prove. The depression at the mouth of White River shown in profiles on Pl. II, accompanying the paper, is becoming obliterated.

The profiles of high water equivalent stages for 47.5 feet in Pl. VIII would indicate a reduction of heights from 1892 to 1893. But where slope as a cause is neglected in the discussion, deductions from one flood are very uncertain. The conditions existing are somewhat similar to those that occurred during the floods of 1882 and 1883, which have been fully discussed by General Comstock.

If on the dates that the gauge at the mouth of White River stood 47.5 feet, the gauge at the mouth of Red River be examined, it will be seen that in 1892 the Red River gauge stands about 44 feet, and in 1893 about 40 feet. As Vicksburg is 206 miles from the mouth of White River, and 165 miles from the mouth of Red River, a simple problem in proportion will indicate that the Vicksburg gauge should have been over 2 feet lower in 1893 than in 1892. The plate shows a difference of 1.5 feet.

The reasons why the Red River gauge stood 4 feet higher in 1892 than in 1893 for the same reading of the White River gauge are equally as evident. In 1892 there was a flood in April which filled up the lower river. In May the 47½ feet at White River occurs before that rise has an opportunity to flow to the Gulf. In 1893 the rise of the Mississippi and its tributaries is much more rapid, and the duration of the flood stage shorter; the 47½ feet occurs at the mouth of White River before the lower river has had an opportunity to fill up. The slope, the propelling force, differs in the two floods.

The only thing that is positively known in reference to gauges is that on a given date the gauge at a certain locality stands at a particular height. No measurements have been made of the area of cross section, velocity of flow, or discharge. With these elements unknown, the comparison of particular cases is dangerous. In Pls. VIII to XII, in the report of the Commission for 1891, are given variations of gauge heights of from 5 to 7 feet for the same discharge, which have arisen from these unknown quantities.

Another assumption implied in this paper is attributing all changes in regimen to the effects of flood heights. The overflow period only lasts a comparatively short time. The forces working from the eight to eleven months that the river is within

its banks may materially modify the results attained when the flow of the ri at its maximum. This is particularly true of stages below 15 feet.

The most violent change in the relation of low-water slopes between Cair points below occurs between the low waters of 1893 and 1894. Levees can nothing to do with this change, as the river never passes above the bank-full during the interval. An examination of the table of low-water readings sh similar tendency in other years in which there were no floods. In other word low-water channel is more affected by long periods of low-water stages than b periods of high water.

With such a number of unknown quantities entering the discussion it result particular gauge ratios can be selected which would appear to verify any t which may be advanced. The literature of the Mississippi River is full of special pleading. Mean results, extending over as long a period as possible, r on the assumption that there is a tendency of these unknown conditions to themselves, are the best that can be utilized. Such means, while giving a m rise in flood heights, also show a slower tendency of the river to enlarge its section.

When the St. Francis levees are completed the reservoir capacity of the above Helena will be reduced from about 6,700 square miles to about 700. S concentration of energy must largely increase the intensity of the action of the in the vicinity of its channel while it is above the overflow stage. The leng time that this action will continue will, however, be correspondingly reduced.

If the concentration of energy tends to enlarge the channel above Helen material scoured from the bed will be moved down the river at a velocity s than that of the water transporting it. As the river falls this material will be taken by water of not sufficient energy to move it onward and will then be depo to be again moved by the next flood. It is, then, possible that the leveeing St. Francis Basin may for a number of years check at certain localities below H the tendency of the river to enlarge its section which has heretofore been obs

Dependence upon enlargement of river section as a method of reducing flood h is uncertain, to say the least. The river must first attain the height to produ results expected, and to the planter ruined by an overflow it affords little conso to know that ten or twenty years afterwards enlargement of river section will pr a recurrence of the disaster.

Waiving all engineering considerations, I believe it most impolitic for the M sippi River Commission to underestimate at the present time the dimensions of required to restrain the Mississippi River. The combined efforts of the Genera ernment and local authorities will have brought the levees of the third distri June 30, 1896, to an average height of about 3 feet above the highest known with ample base and crown. The work of local authorities has been accomp by a most burdensome taxation, to which the people submit only because they b it necessary for their existence. Since the General Government has been m large appropriations there has been a tendency of the local boards to relax efforts. Should the belief become prevalent that flood heights in the third di will not exceed Colonel Suter's estimates these efforts will be reduced quickl minimum.

With sustained efforts for another four years by both State and national au ties these levees can be placed in such a condition as will enable them to resi probable floods, but the present is no time to rest. There is danger of destr to the works already built, and nothing will so certainly paralyze the efforts local engineers to strengthen their levee lines as a statement by the Comm which can be construed that such work is not necessary.

I am making no plea for outlets, but for levees of dimensions adequate for th poses for which they are constructed—to restrain within a narrow channel a fl 2,000,000 cubic feet per second and to protect from overflow a territory exce 29,000 square miles.

As to closing the mouth of Red River, it may be assumed that the more tribu that are diverted from the Mississippi River the less will be its discharge an lower its flood heights. To establish such a proposition it is not necessary to that there will be "lesser future gauge heights at Vicksburg relatively to the of White River" when the 600,000 cubic feet per second that escaped throu crevasses in the Tensas district above Vicksburg in 1893 are confined to the ch of the river.

Very respectfully, your obedient servant,

C. McD. TOWNSEND,
Captain of Engin

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.,
President Mississippi River Commission.

NOTE.—My attention has been called to a confirmation of my assertion increased slope should be used as a measure of increased resistance to flow,

than of less resistance, by a series of experiments by Mr. James A. Seddon, published in the Journal of Engineering Societies for February, 1886. These experiments consisted in allowing a constant flow of water to pass through a trough containing sand and measuring the area of the resultant channel. By varying the angle of inclination of the trough the effect of slope on the form of cross section was obtained. These experiments indicate that the greater the slope for the same discharge the wider and shallower the cross-section, indicating decreased hydraulic mean depths and increase in resistance to flow.

Another illustration is afforded by the remarks of M. Girardon on the improvement of the Canal de Miribel before the Sixth International Inland Navigation Congress. He states that the improvement of the crossings—the reduction of the resistance to flow—has been accompanied by a reduction of the water plane at the upper end of the canal and a raising of the plane at the lower, i. e., a diminution of slope.

APPENDIX 3.

PAPER BY PROF. HENRY L. WHITING, UNITED STATES COAST AND GEODETIC SURVEY, MEMBER OF THE MISSISSIPPI RIVER COMMISSION, ON COMPARISON OF CHANNELS AT NEW ORLEANS IN 1874–1894.

WEST TISBURY, MASS., *June 8, 1895.*

DEAR SIR: I beg leave to submit a statement of some details of comparison I have made between the results of the Coast and Geodetic Survey of that part of the Mississippi River which includes the harbor of New Orleans and its approaches, made in 1872 to 1875, with a similar survey made by the Mississippi River Commission in 1894, thus giving an interval of twenty years in which to study the changes in the channel of the river that have occurred during that time. The results of each of these surveys have been put in the form of a continuous map, extending from about 1 mile above the Twelve Mile Point to about 3 miles below Algiers Point, making a total distance of about 19 miles of the river.

Unfortunately the plane of reference for the soundings on the two maps are not identical, but the difference is slight, between 1 and 2 feet, and does not materially affect the comparison of general and important depths. There is also a slight discrepancy in horizontal scale of from 30 to 50 feet to the mile.

I would further preface my description of detail by asking indulgence for unintentional and unavoidable mistakes arising from the fact that my available data is much less minute and accurate than that of the large scale maps and plans of the Commission. With this qualification, I present the following statement:

On the east (New Orleans) side of the river, from about a mile below and above the Ursuline Convent, not much change in the position of the shore is manifest on the scale of the respective maps. About the convent some irregular waste is shown by a falling back of the shore line.

Opposite the mint and from half a mile below to one fourth mile above it the series of piers and docks that existed in 1874 have been replaced by a continuous line of levee; with this exception there is not much change in the general position of the frontage line.

From the last-named point to a little above Jackson Square there has been a falling back of the front line in places of about 100 feet.

From the last-named point for about half a mile the frontage is now represented by a straight line of work, which for about half this distance has an average advance into the channel of the river of about 200 feet. Beyond this distance the position of the shore line, as given on the two maps, about coincides. Still above this point the general frontage line is in advance of the former one from about 50 to 75 feet.

From about half a mile below Felicity street to about three-fourths of a mile above it there has been a general falling back of the frontage line of from 50 to 75 feet.

From the Elevator to the Windmill (triangulation points common to both surveys) the shore line shows a gradual advance into the channel. At the Windmill there is a wharf structure extending about 200 feet into the former channel, with a natural shore line about 300 feet beyond the former one.

From this point to the upper limit of the City Park there has been a marked advance of the shore line, varying from 100 to 300 feet, with one point where the two lines coincide.

This shows an accretion, as batture, under the eddy currents, caused by the abrupt turn of the river at the point of City Park.

Along the straight northwardly reach of the river from City Park to Carrollton for the first mile and a half there has been a general waste of the steep slope of the river bank varying from about 25 to 50 and 100 feet.

Along the steep concave bend of the river at Carrollton, or rather opposite Nine Mile Point, the crest of the bank has fallen back irregularly—according probably

to the more or less effective protection of revetment and other works. At that point the waste has been about 200 feet. Immediately above this point of waste a straight wharf structure has been built, about 1,600 feet long and directly opposite the most salient part of Nine Mile Point. Each end of this structure is about 25 to 30 feet in rear of the natural shore line. The central part of the structure is about 80 feet beyond the original natural shore line.

About 600 feet above the upper end of this wharf structure the bank has given way about 150 feet.

Above this last-named point, for a distance of about 2.5 miles, there has been an advance of the natural shore line varying from about 125 to 225 feet.

Beyond this point for about 2 miles, to Twelve Mile Point, the advance has increased from about 300 to 400 feet, gradually growing less at the salient part of Twelve Mile Point. Just above Twelve Mile Point the natural shore lines, as given on the two maps, nearly coincide.

On the west side of the river opposite the most salient bend of Twelve Mile Point, the present wharf front of the Avondale Sugarhouse, about coincides with the former natural shore line.

Above this point for about 1.5 miles there has been a waste of bank varying from about 100 to 175 feet.

Below the Avondale Sugarhouse to the La Branch Sugarhouse the waste has been about 200 feet.

From this point to the upper settlement of Nine Mile Point there has been a more gradual coincidence in shore line on the respective maps.

From about half a mile above the most salient part of Nine Mile Point to about 1.5 miles below it there has been accretion in the form of batture varying from 100 to 150 feet. Below this point the accretion increases to 300 and 350 feet as far as the docks of the Company Canal. These works as represented on the maps of 1894 extend about 100 feet beyond those shown on the map of 1874.

From the Company Canal to about 1 mile below the Estelle Sugarhouse there is again a falling back of the shore line varying from about 100 to 400 feet.

From this last-named point to the salient part of Algiers Point, a distance of about 4.75 miles, there is occasional slight change in the position of the shore line, varying, at places, from about 25 to 100 feet of alternate accretion and waste. At one place, about half a mile above Algiers Point, the shore line has made out about 200 feet.

From this locality, around the point of Algiers and so on down the river as far as the maps extend, there is less change in the position of the shore line than is shown elsewhere on the two maps.

The above description is hardly an intelligible explanation, or one that can be followed with a clear impression of the changes referred to. In review of the matter, however, the following table of measures may give a better idea of the situation:

Location of line.	Between 50-foot curves.			Between 100-foot curves.			Maximum depth below 100 feet.	
	Distance.		Difference.	Distance.		Difference.		
	1874.	1894.	1894.	1874.	1894.	1894.	1874.	1894.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Twelve Mile Point*	1,350	1,700	+350	300	700	+400	105	130
Spangenberg	900	1,200	+300				70	80
Nine Mile Point†	1,600	1,600	0	1,200	1,550	+350	150	150
1,000 feet above parallel 29° 56′	1,400	1,700	+300				75	95
Company Canal‡	1,550	1,800	+250	550	750	+200	136	134
City Park	1,500	1,600	+100	900	1,200	+300	168	175
Merrills Landing§	1,100	1,350	+250				85	90
Louisiana avenue§	1,500	1,500	0	0	150	+150	93	103
Gretna‖	1,550	1,400	—150	600	500	—100	120	130
Macdonoughville	1,450	1,600	+150	0	600	+600	81	108
Great Northern Station	1,600	1,550	— 50	0	300	+300	85	108
Algiers Point	1,450	1,600	+150	950	1,200	+250	145	160
Louisa street	1,600	1,700	+100	1,100	1,300	+200	135	154
Ursuline Convent	2,000	1,600	—400	0	300	+300	95	106
1 mile below Ursuline Convent	1,700	1,900	+200				72	80

* Deepest hole downstream 600 feet.

† Deepest hole downstream 700 feet; depth, 58 to 68 feet.

‡ Deepest hole downstream 200 feet; depth, 168 to 180 feet. A second hole 1,500 feet downstream; depth, 100 to 175 feet. Heavy impinging has taken place along the west shore below this line and for about 1¼ miles opposite City Park.

§ A deep hole between these lines has increased from 103 to 123 feet.

‖ A deep hole about 900 feet below this line gave 208 feet in 1874 and 156 feet in 1894. A filling of 52 feet below this point, the same hollow, gave 184 feet in 1874 and 182 in 1894.

At a central point about one-fourth mile above Canal street the bed of the river has shifted toward the Algiers side about 200 feet, probably owing to the removal by scour or other cause of the salient bank that made out from the Algiers shore in 1894.

In review again of the last given table the comparisons show a change of channel way between the 50-foot curves with an average increase in width of about 220 feet, and a channel way between the 100-foot curves with an average increase in width of about 300 feet and an average maximum present (1894) depth of about 120 feet.

As might be expected, the deep holes or pools in the river bed are gradually working down stream and at the bends in the river are gradually trending toward the concave shores.

There are accidents of formation throughout the length of the river, so far as compared, which can hardly be said to indicate the causes or influences that have effected the general character or extent of the more important changes that have taken place. These changes seem, however, to prove the satisfactory and hopeful fact that the river is deepening and widening its channel bed rather than disturbing its high-water outlines. How far this action may be due to levee restraint and revetment protection is a subject worthy of study and examination. It would seem to be a logical resultant of the effect of both of these works.

I have made no estimates of the areas of the cross sections or lines I have selected as giving a fair average of comparison. The data afforded by the two maps are not close or accurate enough for more than such quite general deduction as I have endeavored to make good. My main purpose, with rather limited facilities, has been to show, by this simple and graphic mode of illustration, facts that should satisfy the most unbelieving. The district officers, or their assistants, with their more full and accurate data, can correct and much improve my rather crude attempt at demonstration, if thought worthy of the effort.

Referring to the interesting papers by Colonel Suter and Captain Townsend on the "Effects of recent levee construction," I wish to express my full concurrence in Colonel Suter's views as to the philosophy of divorcing the Red River system from that of the Mississippi. It has always seemed to me that they have different systems of regimen, different sources of water supply in different climates and situations, and, as far as I understand, have different periods of high and low-water stages. Why, therefore, should it be considered good policy or wise engineering to complicate, disturb, and even counteract their action by bringing them together at a point where their constitutional forces have, in a certain sense, lost their incentive power, whether for good or evil.

The statement of Captain Townsend, that "slope (gravity) is primarily the force that is driving the water down the river," seems to me to bear directly on the problem of bringing these rivers together. I think it can be safely said that all rapid-running streams, having, of course, excessive slopes, are shallow. On the other hand, horizontal sections of the same streams, or those having equal volume, are generally, if not always, deeper. The nature of the motive power in each case is also different. In a steep slope the force is an attractive one, of gravity. The particles of water would move as rapidly, excepting momentum, as if no other impelling force was behind them. The cause and effect of these forces seem to me to be clearly proven by the physics of the Mississippi River in its long horizontal course below Red River. The impelling force throughout is not a disturbing one, but uniform pressure of momentum, coherence, and weight of the moving masses.

In my experience of tidal movement I can cite the fact that the effect of the rising tide at Boston Harbor Light-House is felt at the navy-yard, 9 miles distant, in *twenty minutes*, by the impact of particles, whereas it would take many hours for the same particles to pass over the same distance.

I feel reluctant, and incompetent for that matter, to theorise on these problems of the Mississippi River. My experience in such phenomena has been in dealing with effects and resultants rather than with causes. But I am impressed with Colonel Suter's argument for treating the Mississippi River as a unit, particularly in what seems to me the critical portion of its last horizontal section, and not to complicate it by either an outlet system, through the Atchafalaya, or an inlet system, by the confluence of the Red River. The simple comparison I have made has informed my own ignorance of a fact that the other members of the Commission may already know, that the Mississippi is doing precisely what Colonel Suter predicts—preparing her own pathway for her own requirements—which should of course be aided, preserved, and improved by appropriate protective works, and without, to my comprehension, evidences of alarming danger.

Very respectfully, yours,

HENRY L. WHITING,
United States Coast and Geodetic Survey.

Col. G. L. GILLESPIE,
Corps of Engineers, United States Army,
President Mississippi River Commission.

Presented at Army Building, New York City, June 12, 1895.

APPENDIX 4.

REPORT OF CAPT. GEORGE A. ZINN, CORPS OF ENGINEERS, SECRETARY MISSISSIPPI RIVER COMMISSION.

MISSISSIPPI RIVER COMMISSION, OFFICE OF THE SECRETARY,
St. Louis, Mo., May 25, 1895.

COLONEL: I have the honor to submit the following report of the operations of this office from May 31, 1894, to May 25, 1895:

The work of the office has been carried on under allotments made by the Mississippi River Commission from the acts of Congress approved August 18, 1894, and March 3, 1895, and from funds remaining on hand from allotments of previous years. These allotments are as follows:

First. For the "Mississippi River Commission" applicable to salaries of civilian commissioners, expenses of offices of president and secretary, and to expenses of meetings and inspection trips of the Commission.

Second. For "Surveys, gauges, and observations" applicable to the general survey of the river, collection and reduction of physical data, to general examinations, and to a part of the expense of the secretary's office.

Third. For "Dredging experiments." Part of the funds for this allotment were transferred to this office by the officer in charge of the first and second districts on August 16, 1894, and the entire allotment transferred back to him on February 25, 1895.

MISSISSIPPI RIVER COMMISSION.

The Commission held four sessions since the last annual report: June 23–29, 1894, on steamer *Mississippi*, during the inspection trip from St. Louis to New Orleans; August 28–30, 1894, at the Army Building, New York City; November 8–20, 1894, on steamer *Mississippi*, during inspection trip to New Orleans; March 21–27, 1895, on steamer *Mississippi*, during an inspection trip.

The steamer *Mississippi* was laid up at the foot of Neosho street, St. Louis, Mo., after the trip of the Commission in June, 1894. She was put in commission again July 26 and used with the experimental dredge at St. Louis, Cherokee Bar, and Devils Island until September 25, when she was again gotten ready for the inspection trip of November 8, 1894, after which she was laid up at Paducah, Ky. She was put in commission again for the inspection trip of March 21, 1895, and is now laid up at the foot of Neosho street, St. Louis, Mo.

The minor repairs mentioned in the last annual report were made, an extra boiler put in for the steamheating apparatus, and the large ice boxes rebuilt. Her outfit was made more complete by the purchase of a number of small articles.

SURVEYS, GAUGES, AND OBSERVATIONS.

The field work under this head comprised secondary triangulation, topography and hydrography, and gauge inspection, and was of the same general character and scope as that of last year.

The secondary triangulation and stone lines were extended northward from Prairie du Chien to Trempeleau, Wis., a distance of 78 miles by river.

The topography and hydrography was extended northward from Keithsburg, Ill., to Davenport, Iowa, a distance of 55 miles by river.

A topographic and hydrographic survey between high-water bank lines was made during the low-water season from the mouth of the Arkansas River to Vicksburg, Miss., a distance of 200 miles.

One inspection was made of the Commission gauges during low water.

A separate party ran 19 transalluvial profiles from bluff to bluff above Cairo at intervals of about 20 miles for the Alluvial Valley map.

Several limited surveys were made for the experimental dredge work.

Secondary triangulation and stone lines.—At the close of the season of 1893, this work was stopped at a base line near Prairie du Chien, Wis. On June 18, 1894, the triangulation party, under Assistant Engineer A. T. Morrow, took up the work at this point and closed it at Trempeleau, Wis., 78 miles from Prairie du Chien. Forty-one stations were occupied and a base line was measured by steel tape at De Soto, Wis. The average error of closure of triangles for the season was 2.19″. The length of the base is 6,486.35326 feet, with an error of 1 in 929,300. The azimuth of the base is 140° 40′ 24.8″. Twenty-five stone lines were established and 77 stone-line bench marks located on them.

The tables accompanying Principal Assistant Engineer Ockerson's report give descriptions of locations, geographical positions, and elevations of the various bench marks and points occupied.

The secondary triangulation was resumed by Mr. Morrow's party May 3, 1895, at Trempeleau.

Topography and hydrography.—This work was taken up August 25, 1894, at Keithsburg, Ill., where it stopped in 1893, by Mr. Morrow's party, and extended to Davenport, Iowa, 50 miles The tables with Mr. Ockerson's report give the results obtained.

A summary of the condition of the general survey of the river was given in the last annual report.

Low-water survey, Arkansas River to Vicksburg.—The object of this survey was to make a comparison with the first general survey in order to discover what changes had taken place in the bed of the river since that time. Cross sections were taken at 200-meter intervals and careful levels run to bench marks to determine surface elevation and slope.

After closing the field work at Davenport, Iowa, Mr. Morrow's party was transferred on the *Patrol* to the mouth of the Arkansas River, where it was divided into two parties; one party on the survey boat *Illinois*, with the small steamer *Mima* as tender, began the survey downstream at that point; the other, on the *Patrol*, went to Vicksburg and worked upstream. The survey is now being platted and comparisons are being made between cross sections at the same point. It is expected to obtain valuable information from these comparisons. This work is to be extended to Donaldsonville, La.

Gauge inspection.—The *Mississippi* was utilized on her return trip to make an inspection of the gauges and bulletins belonging to the Commission (a list of these gauges will be found on page 2793 of the Annual Report of the Chief of Engineers for 1894). The inspection was made by Mr. Ockerson in a similar manner to that reported last year. The detailed results of the inspection of each gauge are given in Mr. Ockerson's report.

Transalluvial levels.—The object of these levels is to make a map for the upper river similar to the Alluvial Valley map of the lower river, showing the areas of overflow. At the date of the last annual report the map had been projected from Cairo to Keithsburg, and the details from the general survey between Cairo and Cap au Gris, 259 miles by river, transferred to it.

A small party, under Mr. W. S. Williams, began the work July 13, 1894, at Mound City, Ill. Nineteen profiles were run at intervals of 20 miles, the last one being near Port Louisa, Iowa, 468 miles above Cairo. From this point the work will be done by the topographical party now in the field. The high-water outlines were located on the detail maps by inspection on the ground by platting fixed high-water marks established by the residents and from the testimony of individuals who witnessed the high water.

Manuscript charts, etc.—Detailed charts, scale 1:10000, Nos. 132 to 143, inclusive, from La Grange, Mo., to Keithsburg, Ill., have been completed. Charts 81 to 83, Head of Passes northward, have been completed, and Nos. 70 to 80, inclusive, are partially completed. No. 70 covers Donaldsonville, La.

Inch mile sheets 114 to 118, Quincy, Ill., to Keithsburg, Ill., and sheet 32, in the vicinity of the Passes, from the survey of 1893, have been completed.

Upper Alluvial Valley map, scale 1 inch to 5 miles, sheet 1 completed, covers the river from the Ohio to the Illinois; sheet 2 in progress, extends the map to Oquawka, Ill., 440 miles above Cairo.

Published maps.—Detail charts, 1:20000, charts 132 to 136, La Grange, Mo., to head of Des Moines Rapids, and chart 83, have been printed. Charts 137 to 143 and chart 82 are in the hands of the printer.

Inch mile sheet 114 has been printed; sheets 115 to 118 are in the hands of the printer and first proofs have been received.

Gauges.—The daily record of stages at 31 stations on the Mississippi River and 26 stations on the principal tributaries, except the Missouri, have been reduced, tabulated, and platted. The stages for the calendar year 1894 have been published.

Discharge observations.—The only observations of this nature were taken by the district officers. The notes were recomputed in this office and the results tabulated as given in an appendix to this report.

Plant and outfit.—The hulls of the *Patrol* and *Illinois* have gotten in such condition that they must be entirely replaced. The work was advertised for; the lowest bid for the *Illinois*, $2,060, from the Madison Marine Railways, Madison, Ind., was accepted, but the lowest bid for the *Patrol*, $12,000, was considered too great. New specifications are being prepared for the *Patrol*, and it is hoped that the work can be done for considerably less than $12,000.

A boat called the *H. D. Munson*, 120 feet long, 22 feet beam, was purchased at Evansville, Ind., under authority granted by the Commission August 28, 1894, for use principally in gauge inspection, but it is expected to use her for other work in connection with the surveys, etc., so that she will, no doubt, be in commission

throughout the year. She was renamed *Search*, and at present has replaced the *Patrol* with the survey party in the upper river.

Laws.—In accordance with a resolution of the Commission, copies of all acts of Congress passed since 1888 affecting the Mississippi River Commission are hereto appended; the acts passed previous to that date are found in the Annual Report of the Commission for 1889.

Index.—The index to the annual reports of the Commission, ordered by a resolution of the Commission of August 29, 1894, is in preparation and will soon be completed.

An index of published survey and physical data, and an index of discharge observations, in continuation of those published in the annual report for 1889, are hereto appended.

DREDGING EXPERIMENTS.

The allotment for this work was assigned to this office for disbursement in July. The experimental dredge was brought to St. Louis from Memphis by the *Titan* and *Graham*, arriving July 11, and the experiments with the dredge were carried on after that date under the personal supervision of Col. Henry Flad, member of the Commission and of the committee on dredges. The steamer *Mississippi* replaced the *Titan* for a portion of the time because it was necessary to return the *Titan* to Memphis, and it was also believed that it would be cheaper to use the *Mississippi* than to charter another boat for the purpose.

After doing some work above the Merchants Bridge, St. Louis, at Cherokee Bar and Devils Island, the experimental dredge was, in November, 1894, again placed in charge of the officer in charge of the first and second districts, and the funds transferred back to him on February 25, 1895.

The necessary surveys to determine the proper location for the dredge to work were made at each of the places named and also at Liberty Bar (80 miles below St. Louis). Surveys of the channels dredged were also made, and at Devils Island two were made at intervals of about fifteen days, to discover any changes in the channel.

TONNAGE AND TRAFFIC.

It is impossible to obtain accurate statements of the freight traffic on the Mississippi River without employing special agents for their collection. At some points arrangements are made by local bodies for this purpose, but they are so few that the total traffic can only be guessed at.

The most accurate commercial statistics are given for St. Louis, Mo., in the published annual report of the Merchants' Exchange of St. Louis, which contains detailed statements of the trade and commerce of that city.

The secretary of the Merchants' Exchange of Memphis, Tenn., states that 936 steamers arrived and departed from that city during the year. The shipments of cotton by river, northward, for 1894–95 were 27,555 bales; southward, none.

The receipts from the Mississippi River were 160,789 bales. An appended tabular statement gives the varieties and amounts of product received and shipped during the year from that point.

Grays Iron Line shipped from Pittsburg, in 1894, to points on the Mississippi River below Cairo as follows:

To Algiers, La., 3,995 tons steel rails, 228 tons splices, 46,400 pounds bolts, and 280,000 spikes.

From Plaquemine, La., to Pittsburg, 500 M. shingles.

Statement of maps issued, list of civilian engineers, and approximate value of plant, are appended.

Financial statements, detailed and consolidated statements to the end of the fiscal year 1895 will be furnished later for publication with this report.

Very respectfully, your obedient servant,

GEO. A. ZINN,
Captain, Corps of Engineers.

Lieut. Col. GEO. S. GILLESPIE,
Corps of Engineers, President Mississippi River Commission.

Money statement.

MISSISSIPPI RIVER COMMISSION.

July 1, 1894, balance unexpended		$6,063.16
Amount allotted from appropriation, act of August 18, 1894		55,000.00
Amount allotted from appropriation, act of March 2, 1895		15,000.00
		76,063.16
June 30, 1895, amount expended during fiscal year		33,265.62
July 1, 1895, balance unexpended		42,797.54
July 1, 1895, outstanding liabilities	$1,800.00	
July 1, 1895, amount covered by uncompleted contracts		1,800.00
July 1, 1895, balance available		40,997.54

SURVEYS, GAUGES, AND OBSERVATIONS.

July 1, 1894, balance unexpended		$53,477.29
Amount allotted from appropriation, act of August 18, 1894		63,100.00
Amount allotted from appropriation, act of March 2, 1895		113,780.00
		230,357.29
June 30, 1895, amount expended during fiscal year		74,340.16
July 1, 1895, balance unexpended		156,017.13
July 1, 1895, outstanding liabilities	$4,500.00	
July 1, 1895, amount covered by uncompleted contracts	12,040.00	
		16,540.00
July 1, 1895, balance available		139,477.13

Financial statement for the month ending June 30, 1895.

SECRETARY'S OFFICE.

	Improving Mississippi River: Surveys, gauges, and observations.	Improving Mississippi River: Mississippi River Commission.	Total.
Balance unexpended at end of last fiscal year	$53,477.29	$6,063.04	$59,540.33
Appropriated and allotted as per last monthly statement	176,880.00	70,000.12	246,880.12
Total available	230,357.29	76,063.16	306,420.45
Expended during current fiscal year as per last monthly statement	72,537.12	31,707.54	104,244.66
Expended during this month	1,803.04	1,558.08	3,361.12
Total disposed of	74,340.16	33,265.62	107,605.78
Balance unexpended	156,017.13	42,797.54	198,814.67
In treasury	156,880.00	41,500.00	198,380.00
On hand		1,297.54	1,297.54
Overdrawn	—862.87		—862.87
Balance as above	156,017.13	42,797.54	198,814.67
Outstanding liabilities (estimated)	4,500.00	1,800.00	6,300.00
Amounts covered by existing contracts	12,040.00		12,040.00
Total liabilities	16,540.00	1,800.00	18,340.00
Balance available	139,477.13	40,997.54	180,474.67

WORKS ABOVE CAIRO, ACT JULY 5, 1884.

Balance unexpended at end of last fiscal year	$8,600.00
On hand	8,600.00
Outstanding liabilities	39.00
Balance available	8,561.00

Financial statement for the month ending June 30, 1895—Continued.

FIRST AND SECOND DISTRICTS.

	Plum Point Reach.	Plant, first and second districts.	Hickman, Ky.	Dredges and dredging, first and second districts	[Preservation of works.	Surveys, gauges, and observations.	Dredging experiments.
Balance unexpended at end of last fiscal year	$314.03	$11,366.86	$41,031.55	.....	$3,766.26	$604.91	$13,603.05
Appropriated and allotted as per last monthly statement	270,000.00	105,000.00	.....	$230,000.00	20,000.00	12,000.00	.....
Appropriated and allotted since March 2, 1895	330,000.00	70,000.00	.....	350,000.00	20,000.00	10,000.00	.....
Gained by transfer as per last monthly statement	.....	.....	.....	.....	.....	.....	723.03
Received from sales, overpayments, and refundments as per last statement	2,396.97	8.00	171.35	1.20	.....	.....	.....
Total available	602,711.00	186,374.86	41,202.90	580,001.20	43,766.26	22,604.91	14,326.08
Expended during current fiscal year as per last monthly statement	225,484.48	74,995.31	41,202.90	16,575.07	2,870.63	7,557.92	4,311.87
Expended during this month	11,650.87	6,806.04	.....	11,665.09	.....	452.63	.....
Lost by transfer as per last monthly statement	185.10	.....	.....	2,600.00	.....	.....	10,014.21
Total disposed of	237,320.45	81,801.35	41,202.90	30,840.16	2,870.63	8,010.55	14,326.08
Balance unexpended	365,390.55	104,573.51	.....	549,161.04	40,895.63	14,594.36	.....
In Treasury	355,000.00	95,000.00	.....	477,400.00	35,000.00	14,500.00	.....
On hand	10,390.55	9,573.51	.....	71,761.04	5,895.63	94.36	.....
Balance as above	365,390.55	104,573.51	.....	549,161.04	40,895.63	14,594.36	.....
Outstanding liabilities (estimated)	2,000.00	10,000.00	.....	3,000.00	.....	1,000.00	.....
Amounts covered by existing contracts	61,100.00	.....	.....	166,125.04	.....	.....	.....
Total liabilities	63,100.00	10,000.00	.....	169,125.04	.....	1,000.00	.....
Balance available	302,290.55	94,573.51	.....	380,036.00	40,895.63	13,594.36	.....

	Hopefield Bend.	Removal of Nonconnah Rock.	Helena, Ark.	Upper Yazoo levee district.	Upper White River levee district.	Lower White River levee district.	Lower St. Francis levee district.
Balance unexpended at end of last fiscal year	$49.65	$5,153.27	$1,496.10	$9,477.76	$7,745.27	$7,266.68	$13,914.59
Appropriated and allotted as per last monthly statement	.....	.....	.....	100,000.00	53,000.00	75,000.00	90,000.00
Appropriated and allotted since March 2, 1895	.....	.....	.....	98,000.00	51,940.00	73,500.00	86,240.00
Gained by transfer as per last monthly statement	.....	.....	.....	.....	.....	.....	.....
Received from sales, overpayments, and refundments as per last statement	.....	.....	.14	.....	.....	.....	.....
Total available	49.65	5,153.27	1,496.24	207,477.76	112,685.27	155,766.68	190,154.59
Expended during current fiscal year as per last monthly statement	49.65	.50	6.24	107,534.61	57,540.54	76,529.37	97,341.27
Expended during this month	.....	.....	.....	13,734.56	412.55	321.92	2,318.58
Lost by transfer as per last monthly statement	.....	.....	.....	.....	.....	.....	.....
Total disposed of	49.65	.50	6.24	121,269.17	57,953.09	76,851.29	99,659.85
Balance unexpended	.....	5,152.77	1,490.00	86,208.59	54,732.18	78,915.39	90,494.74

Financial statement for the month ending June 30, 1895—Continued.

FIRST AND SECOND DISTRICTS—Continued.

	Hopefield Bend.	Removal of Nonconnah Rock.	Helena, Ark.	Upper Yazoo levee district.	Upper White River levee district.	Lower White River levee district.	Lower St. Francis levee district.
In Treasury	.....	.....	$500.14	$78,000.00	$41,940.00	$73,500.00	$66,240.00
On hand	.....	$5,152.77	989.86	8,208.59	12,792.18	5,415.39	24,254.74
Balance as above	.....	5,152.77	1,490.00	86,208.59	54,732.18	78,915.39	90,494.74
Outstanding liabilities (estimated)	.....	.....	.....	1,000.00	500.00	500.00	600.00
Amounts covered by existing contracts	.....	.....	.....	49,423.39	44,000.00	43,523.30	66,788.60
Total liabilities	.....	.....	.....	50,423.39	44,500.00	44,023.30	67,388.60
Balance available	.....	5,152.77	1,490.00	35,785.20	10,232.18	34,892.09	23,106.14

	Ten model barges.	Improving harbor at Memphis, Tenn.	Improving harbor at New Madrid, Mo.	Improving St Francis River, Ark.	White River levee district.	Total.
Balance unexpended at end of last fiscal year	.....	.....	.....	.....	.....	$115,789.98
Appropriated and allotted as per last monthly statement	$37,500.00	$50,000.00	$20,000.00	$75,000.00	.....	1,137,500.00
Appropriated and allotted since March 2, 1895	.....	.....	.....	.....	$100,220.00	1,189,900.00
Gained by transfer as per last monthly statement	.....	.....	.....	.....	.....	723.03
Received from sales, overpayments, and refundments as per last statement	.....	.....	.....	.....	.....	2,577.66
Total available	37,500.00	50,000.00	20,000.00	75,000.00	100,220.00	2,446,690.67
Expended during current fiscal year as per last monthly statement	37,500.00	38,367.58	20,000.00	75,000.00	.....	882,867.94
Expended during this month	.....	729.83	.....	.....	.....	48,092.07
Lost by transfer as per last monthly statement	.....	.....	.....	.....	.....	12,799.31
Total disposed of	37,500.00	39,097.41	20,000.00	75,000.00	.....	943,759.32
Balance unexpended	.....	10,902.59	.....	.....	100,220.00	1,502,731.35
In Treasury	.....	10,000.00	.....	.....	100,220.00	1,347,300.14
On hand	.....	902.59	.....	.....	.....	155,431.21
Balance as above	.....	10,902.59	.....	.....	100,220.00	1,502,731.35
Outstanding liabilities (estimated)	.....	100.00	.....	.....	.....	18,700.00
Amounts covered by existing contracts	.....	.....	.....	.....	.....	430,960.33
Total liabilities	.....	100.00	.....	.....	.....	449,660.33
Balance available	.....	10,802.59	.....	.....	100,220.00	1,053,071.02

Financial statement for the month ending June 30, 1895—Continued.

THIRD DISTRICT.

	Lake Providence Reach.	Plant, third district.	Surveys, gauges, and observations.	Lower Yazoo levee district.	Upper Tensas levee district.	Middle Tensas levee district.
Balance unexpended at end of last fiscal year	$6,554.09	$14,924.48	$4,903.43	$10,621.87	$10,389.79	$603.16
Appropriated and allotted as per last monthly statement	304,400.00	125,000.00	18,000.00	300,000.00	600,000.00	200,000.00
Gained by transfer as per last monthly statement						105,000.00
Received from sales, overpayments, and refundments as per last statement	4.76				8.16	
Total available	310,958.85	139,924.48	22,903.43	310,621.87	610,397.95	305,603.16
Expended during current fiscal year as per last monthly statement	127,036.66	76,701.50	6,335.61	162,972.78	287,462.25	96,614.21
Expended during this month	391.68	8,336.31	523.34	1,338.40	24,921.70	5,689.76
Lost by transfer as per last monthly statement				*3,000.00	*6,000.00	*2,000.00
Total disposed of	127,428.34	85,037.81	6,858.95	167,311.18	318,383.95	104,303.97
Balance unexpended	183,530.51	54,886.67	16,044.48	143,310.69	292,014.00	201,299.19
In Treasury	164,400.00	66,000.00	16,000.00	147,000.00	294,000.00	178,000.00
On hand	19,130.51		44.48			23,299.19
Overdrawn		—11,113.33		—3,689.31	—1,986.00	
Balance as above	183,530.51	54,886.67	16,044.48	143,310.69	292,014.00	201,299.19
Outstanding liabilities (estimated)	10,131.11	4,886.67	1,200.00	1,310.69	2,000.00	500.00
Amount covered by existing contracts	3,399.40			104,000.00	198,000.00	122,260.00
Total liabilities	13,530.51	4,886.67	1,200.00	105,310.69	200,000.00	122,760.00
Balance available	170,000.00	50,000.00	14,844.48	38,000.00	92,014.00	78,539.19

* Transferred to fourth district.

	Vicksburg, Miss.	Lake Bolivar front.	Stone.	Improving harbor at Vicksburg, Miss.	Improving harbor at Greenville, Miss.	Ashbrook Neck.	Total.
Balance unexpended at end of last fiscal year	$108.07	$104.38	$37,668.99	$10,922.49	$2,249.66		$99,050.41
Appropriated and allotted as per last monthly statement			60,000.00		80,000.00	$85,000.00	1,772,400.00
Gained by transfer as per last monthly statement							105,000.00
Received from sales, overpayments, and refundments as per last statement							12.92
Total available	108.07	104.38	97,668.99	10,922.49	82,249.66	85,000.00	1,976,463.33
Expended during current fiscal year as per last monthly statement			22,423.50	4,124.36	79,814.74	49,109.72	912,595.33
Expended during this month			1,137.37				42,338.56
Lost by transfer as per last monthly statement							11,000.00
Total disposed of			23,560.87	4,124.36	79,814.74	49,109.72	965,933.89
Balance unexpended	108.07	104.38	74,108.12	6,798.13	2,434.92	35,890.28	1,010,529.44

Financial statement for the month ending June 30, 1895—Continued.

THIRD DISTRICT—Continued.

	Vicksburg, Miss.	Lake Bolivar front.	Stone.	Improving harbor at Vicksburg, Miss.	Improving harbor at Greenville, Miss.	Ashbrook Neck.	Total.
In Treasury	.....	.....	$70,000.00	.....	$5,000.00	$25,000.00	$965,400.00
On hand	$106.07	$104.38	4,108.12	$6,798.13	.....	10,890.28	64,483.16
Overdrawn	.....	.....	.....	.....	−2,565.08	.....	−19,353.72
Balance as above	108.07	104.38	74,108.12	6,798.13	2,434.92	35,890.28	1,010,529.44
Outstanding liabilities (estimated)	1.10	7.31	.....	.....	37.54	.....	20,074.42
Amount covered by existing contracts	106.97	97.07	74,108.12	.....	2,397.38	1,660.38	506,029.32
Total liabilities	108.07	104.38	74,108.12	.....	2,434.92	1,660.38	526,103.74
Balance available	.....	.....	.....	6,798.13	.....	34,229.90	484,425.70

FOURTH DISTRICT.

	Lower Tensas levee district.	Atchafalaya levee district.	Lafourche levee district.	Pontchartrain levee district.	Barataria levee district.	Lake Borgne levee district.	Surveys, gauges & observations.
Balance unexpended at end of last fiscal year	$19,605.79	$14,139.52	$10,719.83	$1,716.30	$12,015.28	$7,615.73	$9,470.73
Appropriated and allotted as per last monthly statement	264,000.00	304,000.00	180,000.00	300,000.00	120,000.00	100,000.00	22,000.00
Gained by transfer as per last monthly statement	.....	.....	.....	4,633.04	.....	.....	.....
Received from sales, overpayments, and refundments this month	.20	.....	.....	.....	.....	1.50	.....
Total available	283,605.99	318,139.52	190,719.83	306,349.34	132,015.28	107,617.23	31,470.73
Expended during current fiscal year as per last monthly statement	72,885.65	135,652.44	59,158.10	146,622.36	47,670.41	45,462.75	5,806.09
Expended during this month	790.31	378.52	1,048.66	2,685.30	820.59	253.11	274.23
Lost by transfer as per last monthly statement	65,000.00	4,633.04	.....	.....	.....	.....	.....
Lost by deposit, proceeds of sale of Engineer property	*42,640.00	3,040.00	1,800.00	3,000.00	1,200.00	1,000.00	.....
Total disposed of	181,315.95	143,704.00	62,006.76	152,307.66	49,694.00	46,715.86	6,080.32
Balance unexpended	102,290.04	174,435.52	128,713.07	154,041.68	82,324.28	60,901.37	25,390.41
In Treasury	99,360.00	188,960.00	123,200.00	157,000.00	68,800.00	59,000.00	22,000.00
On hand	2,930.04	.....	5,513.67	.....	13,524.28	1,901.37	3,390.41
Overdrawn	.....	−14,524.48	.....	−2,958.32	.....	.....	.....
Balance as above	102,290.04	174,435.52	128,713.07	154,041.68	82,324.28	60,901.37	25,390.41
Amount covered by existing contracts	10,375.00	13,473.00	9,084.80	.....	.....	.....	.....
Total liabilities	10,375.00	13,473.00	9,084.80	.....	.....	.....	.....
Balance available	91,915.04	60,962.52	119,628.27	154,041.68	82,324.28	60,901.37	25,390.41

* Transferred to Homochitto levee district.

Financial statement for the month ending June 30, 1895—Continued.

FOURTH DISTRICT—Continued.

	New boat.	Homochitto levee.	Improving Mississippi River.	Improving harbor at New Orleans, La.	Improving Atchafalaya and Red rivers, La.	Improving harbors at Natchez & Vidalia, Miss. & La.	Total.
Balance unexpended at end of last fiscal year	.....	.....	$75,283.18	.....	$40,461.01	$77,500.60	$193,244.79
Appropriated and allotted as per last monthly statement	$10,000.00	.....	1,300,000.00	$110,000.00	70,000.00	80,000.00	1,560,000.00
Gained by transfer as per last monthly statement	.....	.....	4,633.04	.....	.....	.....	4,633.04
Gained by transfer during this month	.....	*$30,000.00	30,000.00	.....	.....	.....	30,000.00
Received from sales, condemned Engineer property	.....	.....	43.26	38.63	25.51	.....	107.40
Received from sales, overpayments, and refundments this month	.....	.....	1.70	8.00	.....	.....	9.70
Total available	10,000.00	30,000.00	1,409,961.18	110,046.63	110,486.52	157,500.60	1,787,994.93
Expended during current fiscal year as per last monthly statement	.....	.....	513,259.49	91,892.38	38,474.69	44,253.75	687,888.31
Expended during this month	.....	.....	6,249.02	1,980.71	980.20	1,297.84	10,499.77
Expended by deposit, proceeds sales Engineer property	.....	.....	43.26	38.63	25.51	.....	107.40
Lost by transfer as per last monthly statement	.....	.....	69,633.04	.....	.....	.....	69,633.04
Lost by deposit, proceeds of sale of Engineer property	.....	.....	52,680.00	.....	.....	.....	52,680.00
Total disposed of	.....	.....	641,864.81	93,911.72	39,480.40	45,551.59	820,808.52
Balance unexpended	10,000.00	30,000.00	768,096.37	16,134.91	71,006.12	111,949.01	967,186.41
In Treasury	10,000.00	30,000.00	758,320.00	15,000.00	67,500.00	100,000.00	940,820.00
On hand	.....	.....	27,259.17	1,134.91	3,506.12	11,949.01	43,849.21
Overdrawn	.....	.....	—17,482.80	.....	.....	.....	—17,482.80
Balance as above	10,000.00	30,000.00	768,096.37	16,134.91	71,006.12	111,949.01	967,186.41
Amount covered by existing contracts	.....	.....	32,932.80	.....	.....	46,600.92	79,533.72
Total liabilities	.....	.....	32,932.80	.....	.....	46,600.92	79,533.72
Balance available	10,000.00	30,000.00	735,163.57	16,134.91	71,006.12	65,348.09	887,652.69

* Transferred from levee allotments, 2 per cent of each.

[Current allotments marked *.]

Districts.	Balances.	Appropriations and allotments to June 30, 1894.	Applied by general service.	From sales, etc.	Appropriated or allotted in last year.	Total available.	Expended to June 30, 1894.	Expended during last year.	Total expended.	Total balances.
Des Moines Rapids to Illinois River	$12,663.38	$195,000.00		$145.14		$207,808.52	$207,808.52		$207,808.52	
Illinois River to Ohio River	9,969.15	470,000.00		126.60		480,095.75	480,095.75		480,095.75	
Protection near Cairo*		50,000.00		10.85		50,010.85	41,410.85		41,410.85	$8,600.00
Total above Cairo	9,969.15	520,000.00		137.45		530,106.60	521,506.60		521,506.60	8,600.00
FIRST AND SECOND DISTRICTS.										
Columbus, Ky		41,150.92	$2,599.08			43,750.00	43,750.00		43,750.00	
Hickman, Ky		85,843.17	3,288.83	171.35		89,303.35	48,100.45	$41,292.90	89,303.35	
New Madrid, Mo		1,000.00				1,000.00	1,000.00		1,000.00	
New Madrid Reach		200,721.86	9,640.05	2.83		210,364.74	210,364.74		210,364.74	
Improving harbor, New Madrid, Mo		25,000.00			$20,000.00	45,000.00	25,000.00	20,000.00	45,000.00	
Survey, St. Francis front		14,122.61				14,122.61	14,122.61		14,122.61	
Gauges		2,424.00				2,424.00	2,424.00		2,424.00	
Observations and discharges		6,000.00				6,000.00	6,000.00		6,000.00	
Surveys, examinations, and inspections		3,671.63				3,671.63	3,671.63		3,671.63	
Surveys, gauges, and observations*		28,479.03			22,000.00	50,479.03	27,874.12	8,010.55	35,884.67	14,594.36
Surveys, first and second districts		9,475.84				9,475.84	9,475.84		9,475.84	
Care of plant, first and second districts		84,998.64				84,998.64	84,998.64		84,998.64	
Preservation of works, first and second districts*		20,680.42	3,187.47		40,000.00	63,867.89	20,101.63	2,870.63	22,972.26	40,895.63
Dredging experiments*		a90,708.82				90,708.82	86,396.95	4,311.87	90,708.82	
Hopefield Bend		173,431.78				173,431.78	173,382.13	49.65	173,431.78	
Memphis Reach		147,384.47	52,696.32			200,080.79	200,080.79		200,080.79	
Memphis Harbor and Reach		431,792.38	138,232.94	27.14		570,052.46	570,052.46		570,052.46	
Memphis		372,933.75	8,567.13	22.80		381,523.68	381,523.68		381,523.68	
Improving harbor, Memphis*		25,000.00			50,000.00	75,000.00	25,000.00	39,097.41	64,097.41	10,902.59
Plum Point Reach*		3,644,821.18	364,515.50	2,318.57	600,000.00	4,611,655.25	4,008,944.25	237,320.45	4,246,264.70	365,390.55
Removal of Nonconnah Rock*		6,000.00				6,000.00	846.73	.50	847.23	5,152.77
Helena, Ark.*		66,106.83	10,393.17	.14		76,500.14	75,003.90	6.24	75,010.14	1,490.00
Plant first and second districts*		369,507.35	5,017.40	157.50	175,000.00	549,682.25	363,307.39	81,801.35	445,108.74	104,573.51
Levees:										
Yazoo front		157,406.45				157,406.45	157,406.45		157,406.45	
White River Basin		270,561.44				270,561.44	270,561.44		270,561.44	
Upper Mississippi levee district		139,348.90				139,348.90	139,348.90		139,348.90	
Plum Point		155,924.03				155,924.03	155,924.03		155,924.03	
Protection of levees		1,595.55				1,595.55	1,595.55		1,595.55	
Levees, Long Lake		15,000.00				15,000.00	15,000.00		15,000.00	

a $9,291.18 of original allotment transferred to secretary's office.

Detailed statement June 28, 1879, to June 30, 1895, of all appropriations expended under the Mississippi River Commission—Continued.

[Current allotments marked *.]

Districts.	Balances.	Appropriations and allotments to June 30, 1894.	Applied by general service.	From sales, etc.	Appropriated or allotted in last year.	Total available.	Expended to June 30, 1894.	Expended during last year.	Total expended.	Total balances.
FIRST AND SECOND DISTRICTS—continued.										
Levees, Yazoo, Mississippi-Delta		$100,000.00				$100,000.00	$100,000.00		$100,000.00	
Upper Yazoo levee district *		204,548.65			$198,000.00	402,548.65	195,070.89	$121,269.17	316,340.06	$86,208.59
Upper White River levee district *		103,790.39			104,940.60	208,730.39	96,045.12	57,953.09	153,998.21	54,732.18
Lower White River levee district *		150,000.00			148,500.00	298,500.00	142,733.32	76,851.29	219,584.61	78,915.39
Lower St. Francis levee district *		88,000.00			176,240.00	264,240.00	74,085.41	99,659.85	173,745.26	90,494.74
Survey Helena Reach		8,000.00				8,000.00	8,000.00		8,000.00	
Dredges and dredging, first and second districts *				$1.20	577,400.00	577,401.20		28,240.16	28,240.16	549,161.04
Ten model barges					37,500.00	37,500.00		37,500.00	37,500.00	
Improving St. Francis River, Arkansas *					75,000.00	75,000.00		75,000.00	75,000.00	
White River levee district					100,220.00	100,220.00				100,220.00
Total		7,245,430.09	$598,137.89	2,701.53	2,324,800.00	10,171,069.51	7,737,193.05	931,145.11	8,668,338.16	1,502,731.35
THIRD DISTRICT.										
Lake Providence Reach *		2,985,876.34	255,046.96	223.71	304,400.00	3,545,547.01	3,234,588.16	127,428.34	3,362,016.50	183,530.51
Vicksburg, Miss. *		366,968.70	2,662.27			369,630.97	369,522.90		369,522.90	108.07
Greenville, Miss		348,499.02	58,144.00			406,643.02	406,643.02		406,643.02	
Ashbrook, Neck. *		317,000.00	49,003.87		85,000.00	451,003.87	366,003.87	49,109.72	415,113.59	35,890.28
Lake Bolivar front *		137,329.85	8,028.19	.04		145,358.08	145,253.70		145,253.70	104.38
Plant, third district		231,331.17	17,095.54			248,426.71	248,426.71		248,426.71	
Plant *		113,000.00			125,000.00	238,000.00	98,075.52	85,037.81	183,113.33	54,886.67
Repairs to floating plant		30,000.00				30,000.00	30,000.00		30,000.00	
Floating dock		20,000.00				20,000.00	20,000.00		20,000.00	
Care of plant and surveys		24,360.00				24,360.00	24,360.00		24,360.00	
Gauges		1,461.10				1,461.00	1,461.10		1,461.10	
Observations and discharges		3,000.00				3,000.00	3,000.00		3,000.00	
Surveys, examinations, and inspections		10,149.46				10,149.46	10,149.46		10,149.46	
Surveys, gauges, and observations *		34,138.90			18,000.00	52,138.90	29,235.47	6,858.95	36,094.42	16,044.48
Stone *		100,000.00			60,000.00	160,000.00	62,331.01	23,560.87	85,891.88	74,108.12
Survey Vicksburg Harbor		2,500.00				2,500.00	2,500.00		2,500.00	
Survey unleveed fronts		1,000.00				1,000.00	1,000.00		1,000.00	
Survey Choctaw Reach		2,679.86				2,679.86	2,679.86		2,679.86	
Protection of levees		216,431.83		3.00		216,434.83	216,434.83		216,434.83	
Protection of existing works		25,000.00				25,000.00	25,000.00		25,000.00	
Improving harbor at Greenville *		100,000.00			80,000.00	180,000.00	97,750.34	79,814.74	177,565.08	2,434.92
Improving harbor at Vicksburg *		80,000.00				80,000.00	69,077.51	4,124.36	73,201.87	6,798.13
Vicksburg Harbor—Delta Point	$25,770.13	107,579.88				133,350.01	133,350.01		133,350.01	

Levees:										
Opossum Fork		120,000.00				120,000.00	120,000.00		120,000.00	
Yazoo front		364,878.95				364,878.95	364,878.95		364,878.95	
Yazoo front—Ben Lomond		11,386.22				11,386.22	11,386.22		11,386.22	
Yazoo front—Hughes Break		6,849.69				6,849.69	6,849.69		6,849.69	
Tensas front		566,723.00				566,723.00	566,723.00		566,723.00	
Lower Mississippi levee district		289,944.54				289,944.54	289,944.54		289,944.54	
Tensas Basin, Louisiana		160,072.27				160,072.27	160,072.27		160,072.27	
Tensas Basin, Arkansas		399,591.09		.08		399,591.17	399,591.17		399,591.17	
Lower Yazoo levee district*		354,091.01			297,000.00	651,091.01	343,469.14	164,311.18	507,780.32	143,310.69
Upper Tensas levee district*		608,854.12		8.16	594,000.00	1,202,862.28	598,464.33	312,383.95	910,848.28	292,014.00
Middle Tensas levee district*		215,277.47			303,000.00	518,277.47	214,674.31	102,303.97	316,978.28	201,299.19
Total	25,770.13	8,355,974.47	389,980.83	234.99	1,806,400.00	10,638,360.42	8,672,897.09	954,933.89	9,627,830.98	1,010,529.44
FOURTH DISTRICT.										
Lower Tensas levee district*		282,000.00		.20	156,360.00	438,360.20	266,050.03	70,020.13	336,070.16	102,290.04
Atchafalaya levee district*		307,000.00			296,326.96	603,326.96	298,233.87	130,657.57	428,891.44	174,435.52
Lafourche levee district*		180,000.00			178,200.00	358,200.00	169,280.17	60,206.76	229,486.93	128,713.07
Barataria levee district*		120,000.00			118,800.00	238,800.00	107,984.72	48,491.00	156,475.72	82,324.28
Pontchartrain levee district*		300,000.00			301,633.04	601,633.04	298,283.70	149,307.66	447,591.36	154,041.68
Lake Borgne levee district*		100,000.00		1.50	99,000.00	199,001.50	92,384.27	45,715.86	138,100.13	60,901.37
Red and Atchafalaya rivers		657,500.00		.20		657,500.20	657,500.20		657,500.20	
Surveys, gauges, and observations*		37,121.89			22,000.00	59,121.89	27,651.16	6,080.32	33,731.48	25,390.41
Improving Atchafalaya and Red rivers*		80,000.00			70,000.00	150,000.00	39,538.99	39,454.89	78,993.88	71,006.12
Improving harbor at Natchez and Vidalia*		80,000.00			80,000.00	160,000.00	2,499.40	45,551.59	48,050.99	111,949.01
Improving harbor at New Orleans, La*		80,000.00		8.09	110,000.00	190,008.09	*80,000.00	93,873.09	173,873.09	16,134.91
Natchez and Vidalia Harbor	8,252.04					8,252.04	8,252.04		8,252.04	
New Orleans Harbor	147,670.39	389,183.86	1,527.61	.04		538,341.90	538,381.90		538,381.90	
Levees:										
Tensas Basin		1,163,477.00				1,163,477.00	1,163,477.00		1,163,477.00	
Right bank below Red River		191,892.00				191,892.09	191,892.00		191,892.00	
Left bank below Red River		134,116.00				134,116.00	134,116.00		134,116.00	
Atchafalaya front		176,800.00				176,800.00	176,800.00		176,800.00	
Protection of levees, Tensas front		23,000.00				23,000.00	23,000.00		23,000.00	
Protection of levees		104,000.00				104,000.00	104,000.00		104,000.00	
Gauges		1,878.11				1,878.11	1,878.11		1,878.11	
Observations and discharges		9,000.00				9,000.00	9,000.00		9,000.00	
Observations at Carrollton		3,000.00				3,000.00	3,000.00		3,000.00	
Survey of Cubitts Gap		137.14				137.14	137.14		137.14	
Survey of unleveed fronts		1,000.00				1,000.00	1,000.00		1,000.00	
Bonnet Carre Crevasse		15,000.00				15,000.00	15,000.00		15,000.00	
Mouth of Red River	90,812.40	38,405.00				129,217.40	129,217.40		129,217.40	
Surveys, examinations, and inspections		4,000.00				4,000.00	4,000.00		4,000.00	
Natchez, Miss., survey		1,500.00				1,500.00	1,500.00		1,500.00	
New boat*					10,000.00	10,000.00				10,000.00
Homochitto levee district					30,000.00	30,000.00				30,000.00
Total	246,734.83	4,480,011.00	1,527.61	9.94	1,472,320.00	6,200,603.38	4,544,058.10	689,358.87	5,233,416.97	967,186.41

Detailed statement June 28, 1879, to June 30, 1895, of all appropriations expended under the Mississippi River Commission—Continued.

[Current allotments marked *.]

Districts.	Balances.	Appropriations and allotments to June 30, 1894.	Applied by general service.	From sales, etc.	Appropriated or alloted in last year.	Total available.	Expended to June 30, 1894.	Expended during last year.	Total expended.	Total balances.
SECRETARY'S OFFICE.										
Mississippi River Commission *		$341,115.94			$70,000.12	$411,116.06	$335,052.90	$33,265.62	$368,318.52	$42,797.54
Surveys, gauges, and observations *		1,153,592.70			176,880.00	1,330,472.70	1,100,115.41	74,340.16	1,174,455.57	156,017.13
Rebuilding steamer Mississippi		34,999.88				34,999.88	34,999.88		34,999.88	
Dredging experiments					31,891.18	31,891.18		31,891.18	31,891.18	
Reduction of observations		2,500.00				2,500.00	2,500.00		2,500.00	
Total secretary's office		1,532,208.52			278,771.30	1,810,979.92	1,472,668.19	139,496.96	1,612,165.15	198,814.67
Total	$295,137.49	22,328,624.08	$989,646.33	$3,229.05	5,942,291.30	29,558,928.25	23,156,131.55	2,714,934.83	25,871,066.38	3,687,861.87
Unallotted										3,000.00
Total	295,137.49	22,328,624.08	989,646.33	3,229.05	5,942,291.30	29,558,928.25	23,156,131.55	2,714,934.83	25,871,066.38	3,690,861.87

Consolidated statement of all appropriations expended under the Mississippi River Commission, June 30, 1895.

Act of—	
June 28, 1879	$175,000.00
June 16, 1880	150,000.00
March 3, 1881	1,000,000.00
March 3, 1881	150,000.00
August 2, 1882	4,123,000.00
August 7, 1882	150,000.00
March 3, 1883	150,000.00
January 19, 1884	1,000,000.00
July 5, 1884	75,000.00
July 5, 1884, less $5,000 transferred to snag-boat service	2,065,000.00
July 7, 1884	75,000.00
August 5, 1886, less $5,942.60 for expenses, office Chief of Engineers	1,994,057.40
August 5, 1886, less $47.30 for expenses, office Chief of Engineers	29,952.70
August 11, 1888, less $4,859 for expenses, office Chief of Engineers	2,840,141.00
August 11, 1888	75,000.00
October 2, 1888	35,000.00
October 19, 1888, less $4,214.39 reverted to the Treasury	20,785.61
September 19, 1890	3,200,000.00
September 30, 1890	5,625.00
March 3, 1891	1,000,000.00
July 13, 1892	2,470,000.00
March 3, 1893	2,665,000.00
August 17, 1894	485,000.00
August 18, 1894	2,665,000.00
March 5, 1895	2,665,000.00
Total specific appropriations	29,263,561.71
Balances from former appropriations applied to works below Cairo under act of August 2, 1882, less $123.42, reverted to Treasury $272,504.96	
Same for works above Cairo, under act of July 5, 1884 22,632.53	
Total balances	295,137.49
Total	29,558,699.20

EXPENDED.

Location and object.	To June 30, 1894.	During last year.	Total.
Plum Point Reach	$4,008,944.25	$237,320.45	$4,246,264.70
Memphis Harbor and Reach	1,176,656.93	39,097.41	1,215,754.34
Lake Providence	3,234,588.16	127,423.34	3,362,016.50
Red and Atchafalaya	826,256.59	39,454.89	865,711.48
Levees	7,665,761.32	1,439,131.48	9,104,892.80
Surveys, gauges, and observations*	1,102,615.41	74,340.16	1,176,955.57
Mississippi River Commission	370,042.78	33,265.62	403,318.40
Other works, plant, and miscellaneous	4,771,256.11	724,896.48	5,496,152.59
Total expended	23,156,131.55	2,714,934.83	25,871,066.38
Balance June 30, 1895			3,687,861.87
Unallotted			3,000.00
Total available			29,561,928.25
Less sales and refundments			3,229.05
Total appropriated			29,558,699.20

* Under secretary Mississippi River Commission.

Receipts and shipments via Mississippi River at Memphis, Tenn., during the year 1894

[Statement furnished by Memphis Merchants Exchange, April, 1895.]

Articles.	Received.	Shipped.	Articles.	Received.	Shipped.
Apples.....barrels..	185	2,626	Lard.....pounds..	57,230	429,220
Bran.....sacks..	1,077	2,483	Lumber.....M feet..	98	146
Beans and pease.....barrels..	876	1,108	Liquors.....packages..	1,860	5,149
Butter.....pounds..	63,952	8,370	Meal.....barrels..	3,826	14,122
Bagging.....rolls..	121	14,132	Molasses.....do....	12,145	2,044
Bacon and hams.....pounds..	1,387,466	709,290	Nails.....kegs..	42,066	5,165
Boots and shoes.....cases..	189	5,933	Oats.....bushels..	250	218,192
Corn.....bushels..	73,443	141,866	Onions.....barrels..	451	1,203
Cheese.....packages..	145	2,010	Potatoes.....do....	11,431	8,325
Coffee.....sacks..	744	2,547	Pork, sides.....do....	510,120	2,105,942
Cotton seed.....do....	387,547	1,133	Rice.....do....	.....	753
Cotton ties.....bundles..	58,342	13,907	Sugar.....hogsheads..	.....	257
Dry goods.....cases..	9	3,629	Sugar.....barrels..	2,650	3,544
Eggs.....do....	2,469	473	Tobacco.....packages..	1,485	9,046
Flour.....barrels..	87,791	26,542	Cotton-seed oil.....barrels..	.....	1,211
Hay.....bales..	1,291	70,823	Cotton-seed meal.....sacks..	.....	14,237
Hats and caps.....cases..	.....	440	Cement.....barrels..	1,350	663
Hogs.....head..	799	50	Lime.....cars..	.....	2,113
Sheep.....do....	53	1	Fresh meat.....pounds..	.....	110,300
Cattle.....do....	472	107	Coal.....tons..	151,998	14,467
Horses and mules.....do....	293	1,783			

Statement of charts issued from June 1, 1894, to May 25, 1895.

Description.	Free.	Sold.	Total.
Alluvial Valley	136	152	288
Scale, 1 inch to mile	3,369	289	3,658
Scale, 1 : 20000	4,074	223	4,297
Total	7,579	664	8,243
Proceeds deposited with assistant treasurer of the United States at St. Louis, Mo.			$70.25

List of civilian engineers employed on works under the Mississippi River Commission, in charge of Capt. George A. Zinn, Corps of Engineers, from June 1, 1894, to May 25, 1895.

Name and residence.	Time employed.	Pay per month.	Where employed.	Work on which employed.
	Months.			
J. A. Ockerson, St. Louis, Mo...	12	$250	In field and office ...	In charge of surveys.
A. T. Morrow, Rockford, Ill....	6	175	.....do	Surveys and reduction of field work.
Kivas Tully, St. Louis, Mo.....	12	175	St. Louis office.....	In charge of computing division.
C. W. Clark, St. Louis, Mo.....	12	175	.....do	Platting maps, S. G. O.
W. G. Comber, St. Louis, Mo...	12	150	In field and office ...	Surveys and reduction of field work.
Geo. H. French, St. Louis, Mo..	2	150	.....do	Do.

Approximate value of plant belonging to the United States used on works under the Mississippi River Commission in charge of Capt. George A. Zinn, Corps of Engineers.

Allotment.	Class of property.	No.	Approximate value May 25, 1895.
Mississippi River Commission...	Steamboat Mississippi, with outfit	1	$60,000
	Rowboats	4	150
	Books and furniture	.....	225
Surveys, gauges, and observations.	Steamboat Patrol and outfit	1	8,000
	Steamboat Search and outfit	1	10,000
	Survey boat Illinois and outfit	1	800
	Rowboats	11	100
	Surveying instruments	.....	6,000
	Drawing instruments	.....	400
	Printing plant	.....	630
	Office furniture	.....	700

Abstract of proposals for building new hull for United States steamer Patrol and removing present machinery and cabin thereto received in response to advertisement dated March 25, 1895, and opened May 1, 1895, by Capt. George A. Zinn, Corps of Engineers.

No.	Name and address of bidder.	Amount of bid.
1	David S. Barmore, Madison, Ind	$14,600
2	Ed. J. Howard, Jeffersonville, Ind	13,700
3	St. Louis Sectional Dock Co., St. Louis, Mo	12,000

All bids rejected.

Abstract of proposals for building new hull for United States survey boat Illinois received in response to advertisement dated April 15, 1895, and opened May 1, 1895, by Capt. George A. Zinn, Corps of Engineers.

No.	Name and address of bidder.	Amount of bid.
1	David S. Barmore, Madison, Ind. *	$2,060
2	Ed. J. Howard, Jeffersonville, Ind	2,250
3	St. Louis Sectional Dock Co., St. Louis, Mo	3,250

* Lowest bid; accepted.

LIST OF APPENDIXES ACCOMPANYING THE REPORT OF THE SECRETARY OF THE MISSISSIPPI RIVER COMMISSION.

A.—Report of Assistant Engineer J. A. Ockerson on field work, office reduction, and mapping.
B.—Report of Assistant Engineer A. T. Morrow on secondary triangulation field work from Prairie du Chien, Wis., to Trempealeau, Wis.
C.—Report of Assistant Engineer A. T. Morrow on topographical and hydrographical field work from Keithsburg, Ill., to mouth of Rock River.
D.—Report of Assistant Engineer George H. French on resurvey between high-water bank lines and hydrography from mouth of Arkansas River to Glenora, Miss.
E.—Report of Assistant Engineer W. G. Comber on resurvey between high-water bank lines and hydrography, Vicksburg to Glenora, Miss.
F.—Report of Assistant Engineer Kivas Tully on work accomplished by the computing division.
G.—Index of physical data.
H.—Index of discharge measurements.
I. —Discharge measurements at Ashport Bend, Memphis, Old Town Bend, Greenville, and Wilsons Point in 1894.
J. —Highest and lowest water, 1891 to 1894.
K.—Copy of laws affecting the Mississippi River Commission.

LIST OF PLATES ACCOMPANYING THE REPORT OF THE SECRETARY OF THE MISSISSIPPI RIVER COMMISSION.

1. Secondary triangulation and stone lines, Prairie du Chien to Trempealeau, Wis.
Transalluvial profiles above the mouth of the Ohio River at the following points:
2. Seven and one-half miles above Cape Girardeau.
3. On county line between Jackson and Union counties 2 miles below Grand Tower, Ill.
4. At Wilkinsons Landing, 12½ miles above Grand Tower, Ill.
5. At Brewerville, Ill., 2½ miles above St. Genevieve, Mo.
6. One mile below Kennetts Castle.
7. At Kimmswick, Mo.
8. At Kahokia, Ill., opposite United States Engineer depot at St. Louis.
9. One mile above head of Chouteau Island, at Comstock station, on Cleveland, Cincinnati, Chicago and St. Louis Railroad.
10. One mile below Portage, Mo.
11. At Two Branch Island, 1 mile above St. Peters, Mo., 13 miles above Grafton, Ill.
12. At Sterling, Mo., 34 miles above Grafton, Ill.
13. Four miles below Clarksville, Mo.
14. At Rockport, Ill., 5 miles above Louisiana, Mo.
15. At Hannibal Bridge.
16. At Quincy, Ill.
17. On county line between Hancock and Adams counties, Ill., 5 miles above Canton, Mo.
18. At Burlington, Iowa.
19. At Keithsburg, Ill.
20. At Port Louisa, 8 miles above New Boston, Ill.

Cross sections on stone lines below Donaldsonville as follows:

[Miles below Cairo.]

21	887	29	911.5	37	932.5	45	956	53	979
22	890	30	914.5	38	936	46	959	54	982
23	893	31	917	39	938	47	962	55	985
24	896	32	920	40	941	48	965	56	988
25	899.5	33	923.5	41	944	49	968	57	991
26	902.5	34	926.5	42	947	50	971	58	995
27	905.5	35	927.5	43	950	51	973.5	59	998
28	908 5	36	929.5	44	953	52	976		

APPENDIX 4 A.

REPORT OF ASSISTANT ENGINEER J. A. OCKERSON, ON FIELD WORK OFFICE REDUCTION, AND MAPPING.

ST. LOUIS, MO., *May 25, 1895.*

SIR: I have the honor to submit the following report on field work, office reduction, and mapping during the year—May 31, 1894, to May 25, 1895.

The general character and scope of work has been the same as during the preceding year.

The field work consisted of the usual secondary triangulation and stone lines extended northward from Prairie du Chien, Wis., to Trempealeau, Wis., a distance of 78 miles by river; the continuation of this work northward in May, 1895, from Trempealeau to Wabasha, Minn.

Detailed topography and hydrography from Keithsburg, Ill., northward to Davenport, Iowa, a distance of 50 miles by river; low-water topographic and hydrographic survey between high-water bank lines from mouth of Arkansas River to Vicksburg, a distance of 200 miles; one low-water gauge inspection. Also 19 transalluvial profiles run from bluff to bluff above Cairo at intervals of about 20 miles.

Surveys made in connection with experimental dredge to ascertain effect of current and sediment on dredged channel.

SECONDARY TRIANGULATION AND STONE LINES.

The triangulation party under Assistant Engineer A. T. Morrow reached Prairie du Chien on June 18, 1894, and immediately began the extension of the triangulation and stone lines northward from the upper limits reached in 1893. Forty-one stations

were occupied and 16 tertiary points other than bench marks were located. The average error of closure of triangle for the season was 2.19 seconds, 21 triangles closed large, and 18 closed small.

A base line was measured with steel tape at De Soto, Wis. The length of base is 6,486.35326 feet, 1,977.02276 meters. The discrepancy between the two measurements was 0.00698 feet, or 1 in 929,300.

The number of triangles between the Prairie du Chien and De Soto base lines is 21. The length of the De Soto base computed from the Prairie du Chien base through the 21 triangles is 1,976.9286 meters, a discrepancy between the measured and computed lengths of 1 in 21,000.

The Trempealeau base is 5,223.43093 feet, or 1,592.0874 meters long. The discrepancy between the two measurements of this base was 0.00218 feet, or 1 in 2,396,000.

Number of triangles between the De Soto and Trempealeau base is 22. The length of the Trempealeau base as computed from the De Soto base is 1,592.0338 meters, a discrepancy between the computed and measured lengths of 1 in 29,700.

The azimuth at the De Soto base was determined by observation on Polaris at elongation four nights and δ Ursæ Minoris at elongation one night. Error of chronometer was determined by observing six time stars. For some reason, not yet explained, the range in azimuth results at this station was unusually large and amounted to 13.84″. The mean of the observed results give for the azimuth of the base line 140° 40′ 24.8″. The azimuth carried through the triangles from the Prairie du Chien base gives for the De Soto base 140° 40′ 17.1″, a discrepancy of 7.7″.

The azimuth at Trempealeau base was determined by two nights' observations at elongation of Polaris, δ Ursæ Minoris, λ Ursæ Minoris, and 51 Cephei. The chronometer error was derived from the observations on two nights of four time stars. The mean result for observed azimuth at west base is 272° 40′ 21″. Extreme range, 4.65″. The computed azimuth from the Prairie du Chien base is 272° 40′ 23.9″, a discrepancy of 2.9″ for the total distance covered by the season's work.

Twenty-five stone lines were established and 77 stone-line bench marks located thereon.

Vertical angles were read over each triangle side and also to precise bench marks, and the elevations of the bluffs on which the stations stand were thus determined.

The results of these levels, carried by means of vertical angles read at various times, first from one end of the line and then the other, are very satisfactory. Often an interval of several days elapsed between the readings from the two extremities of the lines.

The vertical angle is measured on a 10-inch circle, the least reading of vernier being five seconds. Each result consists of reading both verniers with circle right and then with circle left. The mean of the two values is the result used. The elevations of the triangulation stations in the following table were determined by duplicate lines of ordinary levels from the nearest precise bench mark. The table shows the discrepancies between the precise levels and levels carried by vertical angles, the former being taken as correct; also the number of lines and distance between benches.

TABLE A.

From station—	To station—	Number of stations.	Length.	Discrepancy.
			Miles.	*Feet.*
Fruitland	Buffalo	14	25	—0.37
Buffalo	Rock Island	6	10	+1.60
Rock Island	Rapids City	13	12	—0.58
Rapids City	Cordova	9	7	—1.03
Cordova	Bellevue	23	52	+1.67
Bellevue	Dubuque	13	17	+1.58
Dubuque	Waupeton	16	21	—0.58
Waupeton	Prairie du Chien	23	33	+0.36
Prairie du Chien	De Soto	22	32	+0.16
De Soto	Trempealeau	22	43	—0.40
Total		161	252	+2.41

The algebraic sum of the discrepancies or the error at the end of a line 252 miles long is 2.41 feet. This, considering the time spent and method employed, must be considered as remarkably good. If reciprocal angles were read at the same time, and more results were obtained for each angle, the results of leveling by means of vertical angles would doubtless show a high degree of accuracy.

The elevations of stations above Memphis datum, from Fruitland to Trempealeau, as determined by vertical angles, is given in Table No. 4.

The descriptions of locations of the secondary stations are given in Table No. 1.

Table No. 2 gives the geographical positions of triangulation stations points together with lengths and azimuths of sides.

Table No. 3 gives same data for the stone-line bench marks.

The secondary triangulation was resumed on April 4, 1895, when M French and one rodman took up the work of reconnaissance and locatio from Trempealeau northward. This work was completed to St. Paul, M 17. There were 60 stations and 2 base lines located. The regular party, u ant Engineer A. T. Morrow, left St. Louis on board the steamer *Search* and arrived at Trempealeau, Wis., on May 3. Work was at once begun an were occupied, 15 triangles closed, and 11 stone lines established up to

Further details of the triangulation field work of 1894 will be found Assistant Engineer A. T. Morrow, Appendix 4 B.

TOPOGRAPHY AND HYDROGRAPHY BETWEEN KEITHSBURG, ILL., AND DA IOWA.

The triangulation party and field equipment was transferred to Keit took up the topographical and hydrographical work on August 25, 1894. began at the upper limit of the field work of 1893 and was extended distance of 50 miles to Davenport, Iowa, which was reached on October

Table No. 5 shows the discrepancies between the precise levels and t levels.

Table No. 6 shows the discrepancies between the two lines of ordinar

Table No. 7 gives descriptions and elevations of the high-water mar in the season of 1894.

Table No. 8 gives the slope of the water surface in the river betwee stone lines as derived from the levels and gauge readings.

Table No. 9 gives descriptions of all bench marks connected with and tion in feet above the Memphis datum.

Further details of the field work will be found in the report of Assista A. T. Morrow, Appendix 4 C.

LOW-WATER SURVEY FROM MOUTH OF ARKANSAS RIVER TO VICK

At the close of the field work at Davenport, Iowa, the steamer *Patrol* boat *Illinois* were brought to St. Louis, and, after taking on board supp October 18, with survey parties and equipment on board, for the m Arkansas River.

The *Illinois* was left at latter point with a party in charge of Assista George H. French, to work downstream. A small steamer, *Mima*, was tender for the survey boat and to aid in sounding.

The *Patrol*, with a party in charge of W. G. Comber, proceeded to Vi there began the work upstream.

The first party began work on October 25 and the second party on The object of the survey was to secure data by means of which a com the first general survey could be made, and the changes in the bed o between the high-water bank lines could thus be ascertained.

The survey consisted of careful soundings on lines normal to the strea intervals of 200 meters, or 8 lines to the mile; the topography of th numerous elevations from which 5-foot contours were developed, and c to determine the water surface elevations and slope.

The work was connected at frequent intervals with bench marks a points of the general survey, so that a direct and reliable comparison

The survey covered 201 miles of river. There were 41,000 soundings were located by 34,000 angles. The entire work was accomplished in working days, or an average of 5.3 miles per day for the two parties.

Further details of the field work will be found in report of Assista George H. French (Appendix 4 D) and report of Assistant Engineer V (Appendix 4 E).

TRANSALLUVIAL LEVELS ABOVE CAIRO.

A party under Mr. W. S. Williams took the field July 13 at Mound City purpose of running profiles across the valley from bluff to bluff and t limits of high-water overflow from the Ohio River northward. The par of Mr. Williams, leveler, one recorder, two rodmen, and a teamster wi a suitable covered spring wagon. The lines were started from bench original survey near the river, were run about normal to the valley an at the bluff end with some well-defined features located by the original vey. A Buff & Berger transit, with a good needle and telescope lev in this work. The azimuth was carried with the needle, which was qu

enough, since both ends of the line were readily connected with the points of the detailed survey. The levels were carried by using the telescope horizontal and reading three horizontal wires on a self-reading rod. These three readings gave also wire interval, from which the distance was readily deduced. Using three wires also practically eliminates errors of rod reading, which are always detected by this process.

There were nineteen profiles run at intervals of about 20 miles, and one or more high-water marks were determined on each line. The first profile is near head of Devils Island, 57 miles above Cairo, and the last near Port Louisa, Iowa, 468 miles above Cairo. Above this point the high water limits and profiles will be run by the topographical party. A total of 103 miles of levels were run in connection with these profiles.

The high-water outlines were located on the detail maps by inspection on the ground, by platting fixed high-water marks established by the residents, and from testimony of residents who witnessed the high waters, all verified to a certain extent by the configuration of the ground.

The length of high-water line located amounted to 410 miles.

The work was completed on September 1, and Mr. Williams and party, except the teamster, joined the topographical party at Keithsburg.

The sections numbered from 1 to 19 are shown on the accompanying plates, 2 to 20.

LOW-WATER GAUGE INSPECTION, NOVEMBER 21 TO DECEMBER 15, 1894.

The steamer *Mississippi* and crew, returning from a Commission trip, were utilized for the inspection and repair of gauges and bulletins pertaining to the Mississippi River Commission. The inspection was made by Assistant Engineer Ockerson, assisted by Leveler C. G. Weyl.

The steamer left New Orleans on November 23 bound for St. Louis. All of the Commission gauges were carefully tested by means of duplicate lines of levels from reliable benches previously established and used for that purpose as described in earlier reports and in "Stages of the Mississippi River."

The discrepancies found at the different stations were noted and the gauge sections were replaced at the proper elevations.

The gauge observers are the same as last year, and the locations of gauges are also the same with the exception of Mhoon Landing, Miss., which was moved down about 300 feet on account of caving banks.

No changes have been made in the elevations of the gauge zeros since the gauges were established.

Some of the temporary gauges set by the observers were found to be in error, the largest being at Bayou Sara, where the gauge readings were nearly 4 feet too high, and at Cottonwood Point, where the error was 0.87 foot, the gauge readings being too high.

The other errors were comparatively small and such as usually occur where the observer carries the stage by temporary stakes.

The unusually low state of river made this inspection especially valuable, and the table of lowest low water of 1894 is quite interesting.

On this inspection it was found that many observers are careless about changing the bulletin, and the readings posted vary widely from the stage indicated by the gauge.

They were told of the importance of keeping the correct reading posted, and the usual promises were made that the bulletins would be properly attended to in the future.

The following instructions were issued to the observers, and it is hoped better results will be obtained in consequence:

INSTRUCTIONS TO GAUGE OBSERVERS.

All gauge observers will strictly observe the following rules:

(1) Readings must be taken by the observer in person at the hours of 8 a. m. and 4 p. m. each day, or, if unavoidably delayed, always note the exact time when the readings are taken.

(2) The stage as read should be recorded on the postal cards addressed to the secretary which are provided for that purpose. These cards should be carried to the gauge and the reading should be noted thereon as soon as obtained.

Copies of these readings will be entered in the gauge book provided for that purpose and duplicates of the cards will be made for the engineer offices, as shown by the addresses on said cards.

(3) The cards will be mailed as soon as practicable after the week's record is completed and the required copies have been made.

(4) The bulletin should at all times show the stage to the nearest quarter of a fo It will be changed morning and evening, whenever there is a change of stage amou ing to a quarter of a foot.

At stations where the stage is affected by the tides the bulletin should show t average of daily high and low readings.

(5) The observer should carefully guard against the destruction of the gauge, a whenever he finds it in danger he should establish a temporary gauge in a safe pla taking great care to have the readings agree with the original gauge.

(6) The column of remarks should be freely used to explain disturbances of t gauge, noting the time when readings change from one section to another, and fact any information which may aid in making the records complete and perfect.

(7) The gauge and bulletin will be put in good order by the inspector about tw in each year. In the interval the observer is expected to make such repairs as m be needed to keep the gauge and bulletin in good order.

(8) At the end of each year the gauge book will be returned to the office of t secretary and a new one will be supplied in its place.

(9) Any serious accident to the gauge or bulletin, any sickness or absence observer necessitating the use of a substitute, should be promptly reported to t secretary.

The steamer *Mississippi* was delayed on her return trip on account of the inspecti only three and a half days.

The results obtained at each station are as follows:

Fort Jackson, La., November 21.—Gauge in one section connected with T. B. M. and found correct.

The observer states that the maximum stage reached during the storm of Octol 8 was about 8 feet on the gauge.

College Point, La., November 24.—Elevation derived from U. S. P. B. M. XIII and t discrepancy at the section in use at time of inspection, reading from 0 to +7 fe was found to be 0.042 foot. This correction to be added to the readings above z and subtracted from the readings below zero.

Section reading from 10 to 15 feet requires a correction of 0.032 foot in the sa direction. The other sections are correct.

The observer states that the lowest reading occurred November 14, when wa stood at —0.95 foot.

Considerable tidal oscillation is observed at this gauge, which complicates accurate determination of stage at low water. At time of inspection the st changed in an hour from —0.05 to —0.15 foot.

Plaquemine, La., November 24.—This gauge was compared with B. M. A. Ewens, 18 The gauge in use at time of inspection was about 400 meters above the regular ga site. The elevation of water surface was determined at the regular gauge site a the temporary gauge was read at same time. The discrepancy in the temporary ga was found to be 0.060 foot. This correction to be added to readings above zero a subtracted from readings below zero.

The observer has used temporary gauges from 23.5 feet down to low water. C section found standing, showed a discrepancy of 0.070 at 14.12-foot mark. Thi practically the same as error found in low-water section. Hence the correction sho be divided proportionally from 23.5 down to 14.5, and then from 14.5 down to l water; apply corrections as found.

Considerable tidal effect is also noted here.

Bayou Sara, La., November 25.—This gauge was compared with B. M. A. Ewens, 18 by means of four separate lines of levels. Below the 20-foot stage the gauge w badly demoralized by sliding banks.

The observer stated that the section in the water (0 to 8 feet) at time of inspect has been read since September 25 in its present position; hence the correction fo September 25 to November 25 should be uniform.

The observer states that on September 25, at 4 p. m., he "raised the readings" foot.

The error in the low-water section (0 to 8 feet) was found to be 3.933 feet, and t correction should be subtracted from all readings from September 26 to date inspection. From the 20-foot stage down to September 25, inclusive, the discrepa 3.933 — 0.6 = 3.333 must be distributed proportionally, as there is nothing to sh where an error occurred, and hence it must be considered as cumulative, and readings should be marked doubtful. A new bulletin was erected just below mo of Bayou Sara. New sections of gauge were put in from —3 to +26 feet.

The observer states that the tidal effect is quite marked. He also says that gauge is sometimes raised "about 2 feet" by the floods from Bayou Sara. Mr. J Irving, jr., states that this bayou effect ranges from 3 to 18 inches, depending on stage of the river.

St. Joseph, La., November 26, 1894.—The bench used in testing this gauge was B. 1 Hider, 1881, and the usual duplicate line of levels was run, checking on the hi water section.

The entire gauge below the high-water section was destroyed on September 15 by a sudden caving of the bank on which it stood.

The observer checked his readings on temporary gauge by the 2-foot hub set last year.

The discrepancy found in the temporary gauge in use at time of inspection was 0.036 foot. This correction is to be added to readings below zero.

The gauge was rebuilt from —8 to +40 feet, the site of the new gauge being about 400 feet above the old gauge site of previous year.

Greenville, Miss., November 27.—The benches used in the examination of this gauge were U. S. P. B. M. 1 C. & G. S. and B. M. O., 1893.

The discrepancy found in the low-water section (—1 to 6) is 0.122 foot. The observer states that knowing this section to be in error he has made a systematic correction of 0.035 foot. This has been subtracted from readings below zero and added to readings above zero, and the actual readings thus corrected have been entered on the records. The error in the record readings are therefore 0.122 — 0.035 = 0.087.

This is to be subtracted from negative readings and added to readings above zero.

The other sections require the following corrections: Section 5 to 9 feet, +0.06; 8 to 21 feet, +0.07; 17 to 23 feet, +0.06; 11 to 17 feet, +0.04; 40 to 46 feet, +0.001.

A new section was put in from 0 to 9 feet.

Arkansas City, Ark., November 28.—Duplicate lines of levels were run from U. S. P. B. M. "F." C. and G. S. and B. M. A. Ewens, 1886, in testing this gauge. The elevations given are referred to P. B. M. F.

The sections below the 22-foot mark situated on the railway incline were destroyed when that structure was dismantled.

The temporary section in the water at time of inspection (—2 to 0) was found to be 0.059 low, hence the correction for readings below zero is to be added and above zero the correction should be subtracted.

The other sections set by observer are as follows: 0 to 3 feet, correction —0.099; 9 to 15 feet, correction +0.151.

Permanent sections are as follows:

	Foot.
Section 22 to 38 feet, correction	+0.001
Section 32 to 41 feet, correction	+0.026
Section 41 to 45 feet, correction	+0.003

New sections were put in on dismantled railway incline from —2 to 22 feet. A 13-foot hub was also fixed to cluster of piling.

Sunflower Landing, Mississippi, November 29.—The high-water section of this gauge is spiked firmly to a large cottonwood tree and is considered as good as any bench mark. Levels were run from the 38-foot mark of this section in testing other portions of the gauge.

The error found in the low-water section (1.5 to 5 is 0.059. This correction is to be added to the readings above zero up to 5-foot stage. Other corrections are as follows:

	Foot.
Section 5 to 11 feet, correction	+0.091
Section 10.5 to 15 feet, correction	+0.026
Section 15 to 19 feet, correction	—0.026
Section 19 to 22 feet, correction	+0.077
Section 22 to 28.5 feet, correction	—0.121
Section 28 to 34 feet, correction	—0.003
Section 33 to 38 feet, correction	—0.018

The inclined section of gauge, 13 to 33 feet, was covered with several feet of silt below the 24-foot mark, which caused this portion of gauge to settle. New vertical sections were set —1 to +5 feet, 5 to 11 feet, and 15 to 20 feet.

Mhoon Landing, Miss., November 30.—This is the most difficult of all the gauges to maintain. The silting up of the bend above Mhoon Landing has pushed the gauge location downstream about 2 miles below its original location; in its present position it is in danger of complete destruction at anytime by caving banks, drift, or ice.

On October 3 the entire gauge below high-water section and bulletin was carried down by caving banks. The observer set a temporary gauge on the following day. The temporary section in use at time of inspection has been in use since November 23.

The bulletin was recovered by observer and set up again near upper Mhoon Landing.

The observer states that all the readings taken after the river fell below the zero stage were read on temporary stakes set by him. The benches used in testing and resetting the gauge are B. M. 4, and 35-foot mark of high-water section.

The error found in section —1 to +5 feet in use, at time of inspection, was 0.038 foot, which should be added to readings below zero.

The gauge was rebuilt in 9 sections from —5 to +41, at a point about 300 feet below the gauge of 1893, where the banks at present are apparently firm.

The bulletin was battered and broken in falling down the bank, and should be replaced by a new one at next inspection trip.

Fulton, Tenn., December 2.—This gauge was tested by levels run from B. M. 1, 1892. The section in the water at time of inspection (+1 to +4), the observer states, has been used for all readings below 4. This section was found to be in error 0.169 foot, the corrections to be added to readings above zero. Other sections require corrections as follows:

	Foot.
Section 4 to 7 feet, correction	+0.013
Section 7 to 10 feet, correction	+0.03
Section 8 to 15 feet, correction	+0.1
Section 12 to 19 feet, correction	—0.048
Section 18 to 24 feet, correction	+0.003
Section 24 to 36 feet, correction	0.000

The sections in error more than 0.05 foot were reset at proper elevation.

Cottonwood Point, Mo., December 3.—Levels were run from B. M. 1, 1892 (Cap.), in testing this gauge. The section in use at the time of inspection was located in front of Dr. Garrett's house, about 3,000 feet above the regular gauge site. Other temporary sections from 12 feet down had apparently been maintained about 500 feet below the regular gauge site.

The elevation of water surface opposite the regular gauge was found by levels to be 0.026 foot, while the temporary gauge opposite Dr. Garrett's house read 0.9 foot. The error in this section is therefore 0.874 foot, the correction to be subtracted from readings above zero.

The errors in other sections are as follows:

	Foot.
Section 2 to 6 feet, correction	—0.924
Section 6 to 12 feet, correction	—0.872
Section 10.5 to 19.5 feet, correction	+0.002
Section 18 to 20 feet, correction	—0.022
Section 22.5 to 26 feet, correction	+0.006
Section 23.5 to 31 feet, correction	+0.006
Section 30.5 to 36 feet, correction	+0.02

New sections were put in from —1 to 19 feet.

New Madrid, Mo., December 4.—This gauge was tested by levels run from B. M. 1, 1892 (Cap.). The sections from high-water mark were found intact, practically as they were placed in 1892. The readings below 10 feet are taken on a gauge set by observer at head of revetment about 330 meters below the regular gauge. This gauge is spiked firmly to a pile driven 10 feet into the river bed.

The error found in this section, reading from 10 feet down to lowest water, was 0.074. This correction to be added to readings above zero to 10 feet.

The errors found in the other sections were as follows:

	Foot.
Section 9.4 to 23.5 feet, correction	—0.005
Section 22.5 to 32 feet, correction	—0.002
Section 31.6 to 45 feet, correction	—0.04

None of the sections were changed as they were all very firm and could not be moved without destroying them.

The reading of the low-water section was compared with the reading of water surface at the regular gauge as determined by levels. A part of the discrepancy noted above may be due to pulsations or irregular waves, which made exact determinations of both water surface and gauge reading difficult.

Belmont, Mo., December 4.—This gauge was tested by levels run from B. Ms. 1 and 2, 1892. The gauge was found intact and practically correct.

The section in water read 3.52 feet, while the elevation of water surface, as determined by levels, was 3.528 feet. The correction 0.008 foot to be added to low-water readings or section 0 to 18 feet.

The correction to section 18 to 48 feet is +0.008 foot.

The bulletin is on elevator and is in good condition.

This station was reached after dark, and the electric search light of the steamer was utilized to illuminate the level target and the ground over which work was being done.

The reflected light from the target was sufficient to illuminate the cross wires in the level and a lantern with a reflector was held near by to enable the observer to see the level bubble. By this means work was done quite as readily as in daylight, although the search light was nearly a fifth of a mile distant.

Grays Point, Missouri, December 5.—This gauge is bolted to the solid rock and on leveling is required. The graduations from 6.2 feet to 16 feet were recut, as the old marks were nearly obliterated by rust.

WHITE RIVER.

Clarendon, Ark., December 15.—This gauge was tested by levels from B. Ms. 1 and 2, 1893. The gauge is firmly attached to the struts between the cylindrical piers, and 18-foot mark is cut in pier. The error found was 0.002 foot, the correction to be added to gauge readings.

Orders were given to transfer the bulletin board down to a point near the gauge. The new location is just below the railroad bridge and at foot of river slope of levee.

ST. FRANCIS RIVER.

Bridge St. Louis, Iron Mountain and Southern Railroad, December 16.—The low-water section reading from 6 feet down was compared by levels with main gauge and was found to be 0.01 foot high. The main gauge is attached to struts between the cylinrical piers, and the tops of these struts are equivalent to bench marks. No change was noted in position of gauge with reference to these struts.

The current in the St. Francis was very sluggish. A surface float was timed over 100-foot base measured with a leveling rod and the velocity found to be 100 feet in 198 seconds. There was no wind at time of test.

The area of cross section was also measured and found to be 906 square feet.

The appended Table 10 gives the lowest low water of 1894 at all of the regular gauge stations from St. Louis to Fort Jackson.

SURVEYS IN CONNECTION WITH EXPERIMENTAL DREDGE.

The experimental dredge arrived from Memphis on July 11, and on the 12th a small survey party, consisting of O. W. Ferguson, one recorder, a leadsman, and four boatmen took the field to select and make a survey of a suitable place for dredging experiments.

Good material was found about 1½ miles above the Merchants Bridge. The site was carefully staked out, gauges and ranges fixed, and a careful survey of the whole area made. As the dredging progressed careful daily measurements were made of the cut, and amount of material excavated was computed. The above work was done on a shore bar for the purpose of testing the machinery and floating pipes and training the crew in the manner of manipulating the dredge and its appliances.

After the necessary experience in manipulation was acquired it was deemed advisable to operate on a channel bar to test the utility of the outfit for actual work. After careful examination of the bars for a favorable site it was finally determined to locate at Liberty Bar, 80 miles below St. Louis. A careful survey of the locality was made and the axis of the cut was fixed. This, however, was abandoned, and the outfit was moved to Cherokee, about 90 miles below Cairo.

At this point a survey of the whole area was made, and after a careful study of the contour and currents the axis of the proposed cut was established straight down the left bank. The channel used by the steamboats made a square crossing just above the site selected for dredging. Ranges were placed, a gauge established, slope and velocity measurements were made, also daily measurements covering the axis of cut, and a sufficient width to ascertain the changes that were going on independent of the dredging.

The bar was composed of gravel and sand. A microscopic analysis of 686 particles gave the following results:

Average size of particles	inch..	0.021
Size of largest particles	do....	0.050
Size of smallest particles	do....	0.007
Percentage of particles smaller than—		
0.01 inch	per cent..	3
0.02 inch	do....	50
0.03 inch	do....	90

Gravel from 0.05 to 1 inch and over.

A very large movement of material along the bed, independent of the dredging, was observed, and hence the dredged channel, which was cut out, did not remain open. The cut along the axis of dredging was at first very much wider and deeper than could be attributed to the material passed through the pipes by the pump, and it was evident that much of the material when loosened by the jets, and which slide in from sides of cut, was swept away by the current.

Early in October, the plant was moved to Devils Island, 125 miles below St. Loui where great difficulty had been experienced by the steamboat men in finding nav gable water for the lightest craft. After a detailed survey covering the enti crossing had been made the axis of the cut to be dredged was laid out from t channel to the right bank opposite mouth of Flora Creek. A cut was made openin a straight channel through the bar, which was made use of by steamboats as soon completed. The usual daily measurements were made as the work progresse Work was completed on November 10, and shortly after the dredge and outfit we transferred to Memphis.

Surveys were made of the dredged channel during the last week in November an on December 12 and 13. The channel was found to be in good condition, and co tinued to be the steamboat channel until close of navigation.

PLANT AND OUTFIT PERTAINING TO SURVEYS, GAUGES, AND OBSERVATIONS.

The steamer *Patrol* and survey boat *Illinois* were in use on the upper river unt October 17, when they were transferred to the lower river, and used on the low water survey until December 13. They were then ordered to Cairo and finally Paducah, where they were laid up pending extensive repairs which it had bee decided to make.

Plans and specifications were prepared for new hull for survey boat *Illinois*, tra ferring cabin thereto and putting entire boat in good order. This work is now progress.

Plans and specifications were prepared in Colonel Suter's office, under the direct of Assistant Engineer A. H. Blaisdell, for a new hull for steamer *Patrol*, 128.4 f long, and transferring cabin and machinery thereto.

Seven skiffs have been condemned and sold. Repairs have been made to the se iceable skiffs, which are in fairly good order.

Many of the topographical instruments are practically worn out and some n ones will be required in the near future.

On August 28, 1894, the Commission authorized the purchase of a steamboat, t used in connection with the work of surveys, gauges, and observations. On A 18, 1895, a boat was purchased at Evansville, Ind., for the sum of $9,000. This b called the *H. D. Munson*, is 120½ feet long, 22 feet beam, and 4-foot hold

It has compound noncondensing engines; 2 steel boilers 16 feet long, 38 inche diameter, with 6-inch flues in each boiler. Her tonnage is 149.80. She was buil 1893, and is in very good condition. She was taken to Paducah at once, where of survey outfit was transferred from the *Patrol*. The bulkheads were moved board 2 feet, and new bulkheads put in to provide for galley and mess room main deck; some minor changes were also made on the boiler deck to better ad it to the uses of a survey party. The boat reached St. Louis on April 24, where necessary outfit was completed and the boat put it commission on the survey w While in port the name of boat was changed from *H. D. Munson* to *Search*.

OFFICE REDUCTION AND PLATTING.

The office reduction during the year, aside from considerable miscellaneous w has consisted of the computations and final reductions of the triangulation, line, and azimuth field work of 1894; platting topographic and hydrographic note of survey, Kiethsburg, Ill., to Davenport, Iowa; platting field notes of t graphic and hydrographic low-water survey, Arkansas River to Vicksburg; plat the cross sections of the latter survey for comparison with sections platted of su of 1881 and 1882; platting and drawing profiles of transvalley levels above C plates 2-20; and stone line sections below Donaldsonville, plates 21-59; maps prepared showing controlling levee lines below Cairo, Ill., up to 1894; computa of water-surface slope, elevation of high-water marks, and discrepancies in l covered by the field work of 1894; current gauge records were reduced, tabulated, hydrographs platted for the year 1894; index of physical data and index of disch work were prepared; yearly high and low water 1891-1894 was tabulated; gen subject index of annual reports Mississippi River Commission, and the index tabulating, and care of notebooks, plats, and miscellaneous matter in the office

MAPPING AND PUBLICATION.

Detail charts.—Work has been continued on the detail charts, scale 1:10000, cha 132, 133, 134, 135, and 136, from La Grange, Mo., to head of Des Moines Rapids, fie work of 1892 were completed and printed in July, 1894. Charts 137, 138, 139, 14 141, 142, 143, head of Des Moines Rapids to Keithsburg, Ill., field work of 1893, we completed and sent to printer May 6, 1894. Chart 83, Head of Passes to Jump, La field work of 1893, has been completed and printed. Charts 81 and 82, following 83

above the Jump, have been completed, and 82 is in the hands of the printer. Charts 70 to 80, both inclusive, survey of 1893 and 1894, are partially completed. One hundred and fifty copies each of charts 122 to 136, both inclusive, were sent to the Chief of Engineers, U. S. Army. Inch-mile sheets 114, 115, 116, 117, and 118, Quincy, Ill., to Keithsburg, Ill., have been completed. Sheet 114 was received from the printer in July, 1893. The other sheets named are in the hands of the printer and first proofs have been received. Sheet 32, in the vicinity of the Head of Passes, from the survey of 1893, has been completed. One hundred and fifty copies each of sheets 101 to 114, both inclusive, were sent to the Chief of Engineers, U. S. Army.

Upper Alluvial Valley map, scale 1 inch=5 miles.—This map, when completed, will show in colors the areas along the Mississippi River subject to overflow and cross sections of the valley at intervals of about 20 miles. The first sheet of this map extends from mouth of the Ohio River to a short distance above the mouth of the Illinois River, and in longitude from about 89° to 93°. It is reduced from the detailed surveys of the Mississippi and Missouri rivers, on which it is based, and shows the latter stream from mouth to a short distance above Booneville, Mo. Outside of the surveyed limits the data for the map is derived from the land-survey maps, verified by such other reliable matter as can be obtained. This data consists of water courses, county lines, county seats, and railroads. All of the outlines of this sheet and lettering of counties, towns, railroads, etc., have been completed. Sheet 2 extends from upper limits of sheet No. 1 to Oquawka, Ill., 440 miles above mouth of Ohio. On this sheet the Mississippi River and adjacent bluffs covered by the general survey has been reduced, transferred, and inked, the outlying portions of map have been reduced and transferred.

Stages of the Mississippi River and principal tributaries for 1894 have been printed.

Blue prints of field plats, as soon as completed, have been furnished district officers and others for immediate use, thus making the results of the survey available at once, instead of waiting for the completion and publication of the detail charts.

Everyone connected with this service has a personal interest and pride in the successful prosecution of the work, and faithfully strives to cover as large a field as accuracy of results will permit. The amount accomplished, as outlined in the foregoing report, is due to this unselfish devotion to duty manifested by all who have shared in the work.

Very respectfully, your obedient servant,

J. A. OCKERSON, *Assistant Engineer.*

Capt. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 B.

REPORT OF ASSISTANT ENGINEER A. T. MORROW ON SECONDARY TRIANGULATION FIELD WORK FROM PRAIRIE DU CHIEN TO TREMPEALEAU, WIS.

ST. LOUIS, MO., *October 15, 1894.*

SIR: I have the honor to submit the following report on the work done by the triangulation party under my charge during the summer of 1894:

On June 13, in obedience to your orders, I left St. Louis, accompanied by two assistants and six men, and proceeded to Keokuk, Iowa, where I found the steamer *Patrol* and quarter boat *Illinois* in readiness for the season's work.

On the following day the steamer took on some additional supplies and proceeded to the upper river, reaching Prairie du Chien on the evening of June 18. The party was there joined by other assistants, and the work was begun on the line △ North McGregor and △ Dousman, the upper limit of the previous season's work.

The party was organized as follows: A. T. Morrow, in charge; George H. French, reconnaissance; C. L. Ockerson, secondary angles; O. N. Axtell, stone lines and tertiary triangulation; T. C. Hockridge, station building; F. G. Ray, field computations and recording; W. H. Roper, recording on secondary work.

In addition to these there were the crew of the steamer and twelve men, the entire party numbering 28 persons.

From Prairie du Chien the triangulation was carried to Trempealeau, Wis., and there closed on the Trempealeau base on August 18.

The extreme low water of the river prevented the progress of the steamer beyond Trempealeau, and the prevalence of smoke from the forest fires made the work slow and unsatisfactory. These facts were reported to the office and your orders were received to close work and proceed to Keithsburg, Ill., to take up topography.

The down-river trip was begun on August 16. A stop was made at De Soto, Wis to complete some unfinished work which, owing to prevalence of smoke and fo required three days for its completion. The steamer left De Soto on the morning August 20 and reached Keithsburg on the evening of August 23, after a slow an laborious trip over the extreme shallow water of the river.

The territory over which the triangulation was carried this year is to some exten different from that of previous years.

The bluffs are higher and wooded with smaller timber.

The valley consists of a network of islands, channels, and sloughs, which gener- ally extend from bluff to bluff.

The work of reconnaissance and station building was considerably facilitated by the higher and less wooded bluffs, but these advantages were to a considerable extent counterbalanced by the increased difficulty of reaching the work from the steamer. The prevalence of sloughs in the bottoms prevented travel across them on foot or by team, and during the low-water season these sloughs could rarely be navi- gated by skiffs. As a consequence long detours were generally necessary to reach the bluffs, and toward the close of the season it became necessary to do a good deal of the work by detached parties. A larger number of ground stations were used this year than heretofore and a large number of lines passed near the ground. Drought and hot weather prevailed during most of the time, and the atmospheric conditions were unusually bad. Our average error of closure was greater than that of the previous season, a result which I attribute to atmospheric disturbances caused by the dry, hot weather and to the close proximity to the ground of a large number of our lines. I am inclined to the opinion that it would be economy to dispense with ground stations, except in rare cases where the ground drops rapidly away from the point occupied and all lines pass, at least 10 feet above the ground, at intervening points.

Two base lines were measured, one at De Soto and the other at Trempealeau, and azimuth observations were taken at both these places.

The work of the season covered a stretch of 78 miles, and occupied two months time.

Very respectfully, your obedient servant,

A. T. MORROW, *Assistant Engineer.*

First Lieut. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 C.

REPORT OF ASSISTANT ENGINEER A. T. MORROW ON TOPOGRAPHICAL AND HYDROGRAPHICAL FIELD WORK FROM KEITHSBURG, ILL., TO MOUTH OF ROCK RIVER.

ST. LOUIS, MO., *October 20, 1894.*

SIR: I have the honor to submit the following report on the work done by the topographical party during the field season of 1894:

On August 23 the steamer *Patrol* and quarter boat *Illinois*, with the triangulation party on board, reached Keithsburg, Ill., preparatory to taking up topographical work at the limit of the work of 1894.

On August 24 a number of assistants arrived from St. Louis. That day was spent in renovating the steamer and quarter boat and in making preparations for the field work.

On August 25 the work was begun, with four parties in the field. The force was increased by additions from the office and men were employed on the ground until there was a full working force of 63 persons, early in September.

The organization of the party was as follows: A. T. Morrow, in charge; W. Comber, George H. French, Eugene L. Harman, C. L. Ockerson, E. J. Thomas, O. Axtell, and W. S. Williams, topography; T. C. Hockridge and F. G. Ray, hydrography; C. A. Bonfils and W. H. Roper, ordinary levels; F. F. Axtell, platting.

The work was carried on in accordance with the methods heretofore in practice with the exception that some additional work was done outside the limits of detail topography in the way of outlines of creeks, railways, and sand ridges, and more complete details in bluff line work.

The weather and the stage of river were in the main favorable for the work and the party suffered much less from malaria than during the previous season.

The assistants were nearly all men of experience in their work and worked together energetically and harmoniously, maintaining a good rate of progress and, I think, accomplishing a season's work that will prove to be of high order throughout.

The work of the season was closed at the mouth of Rock River on October 12, having made a progress of 50 miles in fifty days.

Mr. W. S. Williams, with the bluff line party, was left in the vicinity of New Boston to finish a small amount of slough work near the head of Sturgeon Bay.

On the afternoon of the 12th of October the steamer left Rock Island with quarter boat in tow and the party on board and reached St. Louis on the morning of October 17, where the party was paid off and turned over to Messrs. Comber and French for service on the lower river.

Very respectfully, your obedient servant,

A. T. MORROW, *Assistant Engineer.*

First Lieut. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 D.

REPORT OF ASSISTANT ENGINEER GEORGE H. FRENCH ON RESURVEY OF SHORE LINE AND HYDROGRAPHY FROM RIVERTON LANDING TO GLENORA LANDING, MISSISSIPPI.

ST. LOUIS, MO., *December 18, 1894.*

SIR: I have the honor to submit the following report of field work on resurvey of shore line and hydrography from October 25 to December 13, 1894, between Riverton Landing and Glenora Landing, Mississippi, where the work was connected with that of the parties on the steamer *Patrol*, Assistant W. G. Comber in charge, which had worked up from Vicksburg, Miss.

According to your written instructions I took charge of the quarter boat *Illinois* at St. Louis, Mo., October 18, with the following party: Assistant George H. French, in charge; Messrs. C. L. Ockerson, W. S. Williams, topography; F. G. Ray, B. F. Williams, hydrography; W. H. Roper, levels; F. F. Axtell, draftsman; 1 cook, 2 waiters, 1 mate, 4 rodmen, 1 leadsman, 2 stadia men, 1 watchman, 9 axmen.

Detailed instructions as to the scope and character of the work were received from Mr. J. A. Ockerson, principal assistant engineer.

At noon on October 18 we left St. Louis in tow of steamer *Patrol* and the morning of the 25th took the steamer *Mima* in tow at Cumbyville, Ark. The *Mima* had been chartered for use in sounding and moving the quarter boat, the owners furnishing pilot, engineer, and fireman, thus making a total of 31 persons in the party. The same morning we were landed near the mouth of the Arkansas, the *Patrol* proceeding to Vicksburg.

TOPOGRAPHY.

The shore line was run in the usual way with transit and stadia checking on fixed points of the general survey. Besides this C. Ps., or connecting points double flags, white over red, were put up at from 1 to 1¼ miles apart on both shores so as to be seen from each other and a set of these angles read from each, thus carrying an independent azimuth from the stadia-line azimuth. Whenever it was convenient both shore-line parties exchanged azimuth and distance between C. Ps. on opposite shores. From 3 miles above Greenville to halfway between Vauclause and Sunnyside landings Assistant Arthur Hider furnished us with the geographical positions of tertiary points used in his recent survey of Greenville Reach.

Sand bars were developed for 5-foot contours back to the line of large willows.

SOUNDINGS.

Soundings were done in the usual way, with the exception that sections were sounded every 125 meters on all crossings. On account of numerous snags and cross currents it was impossible sometimes to get as near the shore in caving bends with the steamer as with the yawl.

LEVELS.

Ordinary levels were run on one shore only and checked on benches of the general survey. Water surfaces were taken every quarter of a mile so as to determine the slope.

The weather and stage of water being favorable for a low-water survey and the health of the party good, the work was pressed forward as rapidly as possible.

The length of river covered by the survey was 99 miles. Four days were lost on account of rain and smoke, making a total of thirty-nine working days in the field, or near an average of 2½ miles per day.

SUMMARY OF SOUNDINGS.

Miles of river sounded	
Cross sections sounded	8
Cross sections per mile of river	
Soundings per mile of river	1
Soundings per cross section	
Total soundings	16,5
Sextant angles read in locating soundings	13,5

Respectfully submitted.

GEO. H. FRENCH, *Assistant Engine*

First Lieut. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 E.

REPORT OF ASSISTANT ENGINEER W. G. COMBER ON THE RESURVEY OF THE REA VICKSBURG TO GLENORA LANDING.

OFFICE MISSISSIPPI RIVER COMMISSION,
St. Louis, December 18, 189

SIR: I have the honor to submit the following report concerning the work don the hydrographic and topographic party under my charge during the field sea just ended:

In accordance with your written instructions dated October 16, 1894, the sur party left St. Louis at noon, October 18, 1894, on the survey steamer *Patrol*, a receiving supplies, having the quarter boat *Illinois*, with Mr. French's party board, in tow; detailed instructions as to the character and extent of work v received from Mr. J. A. Ockerson, principal assistant engineer.

The quarter boat *Illinois* was left at the mouth of the Arkansas River Octobe the *Patrol* arriving at Vicksburg October 27, some delay having been experience the way down in endeavoring to secure a steam launch for soundings.

The party was organized as follows: W. G. Comber, chief of party; T. C. H ridge and E. D. Jones, hydrographers; E. L. Harman and O. N. Axtell, topo phers; C. A. Bonfils, leveler, and Gustav Bischoff, draftsman.

The work was begun on the line 600 miles below Cairo (inch-mile map) proceeded with up the river to a junction with the party under Mr. French, the 500-mile line below Cairo.

Great assistance was rendered to the party over the reach, Look Out Poin Carolina Landing, by the tertiary triangulation azimuths and positions of the struction engineers in the vicinity, a copy of these positions, etc., having received from Arthur Hider, assistant engineer at Greenville. These tertiary tions included four of the original Coast and Geodetic Survey secondary station

The health of the party was excellent, only one man being sick and unfit for one day during the entire field season.

The time actually employed in the field work of the survey was thirty-seven d making an average progress of 2¼ miles per day.

The progress of the work is largely due to the industry and skill of my assist

HYDROGRAPHY.

Some delay was experienced by the hydrographers by the nonarrival of mirrors for the sextants, which went astray through the mails. The soundings proceeded with, however, and located by means of transit angles until the ar of the mirrors, when they were located in the ordinary way.

No steam launch having been secured, the sonndings during the early part of work were taken in a four-oared yawl; during the latter part of the work from six-oared yawl.

In the pools soundings were taken on lines crossing the river normal to the str 250 meters apart. On the crossings similar lines were sounded 125 meters ap these distances were paced on the bar side; afterwards true distances were d mined by transit and stadia.

Owing to the low stage of the river very little current was found over the en reach, except on the crossings, where the current was generally quite strong, e cially in the vicinity of Lake Providence, where it became necessary to double force at the oars of the four-oared yawl.

les of river sounded	102
xtant angles used in locating soundings	18,790
ansit angles used in locating soundings	1,687
oss sections sounded	818
rerage cross sections per mile of river	8.02
rerage soundings per mile of river	244.5
rerage soundings per cross section	29.9
otal soundings	24,459

TOPOGRAPHY.

The topography of the survey was done by Mr. E. L. Harman on the left bank nd Mr. O. N. Axtell on the right bank, with occasional assistance from myself. me delay and inconvenience were caused by the few azimuths attainable with asonable work on the caving-bank sides, one stone being usually gone and somemes both, and on the bar sides the stone line was usually grown up to such n extent as to make the obtaining of an azimuth the work of considerable time. his difficulty was overcome and good azimuths carried by the use of a series of red nd white flags about 2 miles apart and using them to carry an independent azimuth ine to check the stake azimuths.

These red and white flags, called in field parlance connection points, were also seful to check up the topographers' work with each other, assist the draftsman in latting the lines, and for signals by the hydrographers.

Azimuths were obtained from the stone line bench marks at intervals of about 15 iles, except in two instances, when observations of Polaris at elongation were used.

Over the reach Look Out Point to Carolina Landing the tertiary azimuths and posiions of the construction engineers were used in addition to the stone line bench arks.

LEVELS.

Ordinary levels were carefully run to determine the river slope and check the opographers' stadia elevations. These levels were usually carried on the bar side of he river, closing on the ordinary bench marks of the former topographic survey, nd where practicable on the precise bench marks. Very few of the last were found, owever.

River crossings were made at the upper end of the bars to transfer the elevation om one bar to the next above with two instruments and ten simultaneous readigs each way; B. & B. level No. 614 and W. B. transit No. 64 were generally used r this work and gave very satisfactory results. Care was taken to get the very est time for making these crossings.

PLATTING.

Main stadia lines were platted in the field, except the last few days' field work,) that any errors found might be corrected while in the vicinity, and the detail opography for the first 50 miles, or about half the work, was also platted and rawn during the field season.

Very respectfully, your obedient servant,

W. G. COMBER, *Assistant Engineer.*

First Lieut. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 F.

EPORT OF ASSISTANT ENGINEER KIVAS TULLY ON WORK OF THE COMPUTING DIVISION.

MAY 21, 1895.

APTAIN: I have the honor to submit the following memorandum of work accomhed under your direction by this division, from May 31, 1894, to May 21, 1895:

he reduction of the discharge observations of 1893 at Carrollton, La., was finid and printed, which completed the pamphlet of discharge results for that year.

he discharge measurements of 1894 below Cairo consist of 2 in the first district, the second, and 5 in the third district—12 discharges in all.

he results of reduction in the district offices have been tabulated. The field s of these observations have been received and copies made, in accordance with

resolution of the Commission, and the originals returned to the district officers. All but two of these observations were made in the low-water season, and eight of them are at lower stages than were ever before measured at the same places.

A pamphlet has been compiled and is being printed containing in condensed form the results of all obtainable series of discharge measurements on the Mississippi River and tributaries, arranged by stations.

This work involved, besides references to all previous publications, consulting many of the field books of earlier years to supply data and the reduction of gauge readings of different series at the same place to a common gauge when possible. The portion now in print, 69 pages, covers the Mississippi River from St. Paul, Minn., to Greenville, Miss., about 1,388 miles of river.

The annual pamphlet of daily stages of the Mississippi River and principal tributaries and the Atchafalaya for 1894 was prepared and issued. This pamphlet contains the records of 56 stations. Seventeen of these gauges are maintained by the Mississippi River Commission, and 23 under direction of Captain Willard. These are read twice daily, at 8 a. m. and 4 p. m., and the reports received weekly at this office, where the daily means are taken out and tabulated and platted on the office hydrographs. Each reading of the Mississippi River Commission gauges is also platted to a larger scale to detect any errors of observation, and in case any discrepancies are discovered they are referred back to the observer for explanation. The other records in the pamphlet are mainly received at the end of the year and arranged for printing.

The regular hydrographs, showing all of these records, were prepared in three sheets and blue printed.

Reports of inspections of gauges are examined as received, and any necessary corrections due to errors in gauges as found by leveling are applied and note of such corrections made in the printed pamphlet. Monthly reports of certain gauges have been sent out in blue print.

The index pamphlet to proceedings of the Commission from January, 1891, to August, 1894, inclusive, was prepared and issued; also the index to resolutions of the Commission of a general character from 1889 to 1894, inclusive, with a copy of the resolutions, was prepared and printed in continuation of the pamphlet to 1888.

The index to annual reports of the Commission ordered by resolution of August 29, 1894, is in preparation; the subject head is arranged in part to the letter R, and the personal index in slips ready for distribution.

An index of published survey and physical data Mississippi River, to 1894, has been prepared for the annual report.

An index of discharge observations and tables of highest and lowest yearly gauge readings, 1891 to 1894, for stations on the Mississippi River and tributaries, are also prepared for the annual report.

Tables of highest and lowest gauge readings for 1894 compared with previous highest and lowest readings were prepared and issued in blue print.

A preliminary plat of low-water profiles, Cairo to Fort Jackson, has been made for study and comparison; also plats of discharge observations and gauges at mouth of Red River and in lower Old River of earlier years.

The following additional pamphlets were printed during the year:

Restricting Flood Heights on the Lower Mississippi, by Capt. John Millis.

Effect of Recent Levee Construction, with suggestions, for Relief of Lower Louisiana, etc., by Colonel Suter.

Influence of Basins on Flood Heights, Mississippi River, by Captain Townsend.

Report of Committee on Dredges, etc., by Colonel Flad and Major Harrod.

Considerable miscellaneous work of a routine character has been done connected with the office files and reports and proof reading.

Mr. George H. Johnson has assisted in the work from August 15, 1894, and Mr. Charles M. Talbert during the year, and Mr. E. J. Thomas to September, 1894, and to their efforts the accuracy of the work is mainly due.

Very respectfully, your obedient servant,

KIVAS TULLY.

Capt. GEO. A. ZINN,
Corps of Engineers, U. S. Army,
Secretary Mississippi River Commission.

APPENDIX 4 G.

VEY AND PHYSICAL DATA, MISSISSIPPI RIVER, EXCEPT DISCHARGE
S, PUBLISHED IN UNITED STATES OFFICIAL REPORTS TO 1894,

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Sediment apparatus observations of 1879 on Mississippi, Arkansas, and Missouri rivers, illustrated report.	Chief of Engineers.....	1887	3121
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List of, issued by the Mississippi River Commission to 1895	.....	.....	.....
Map of the Alluvial Valley of the Mississippi River from head of the St. Francis Basin to the Gulf of Mexico, showing area subject to overflow, scale 1 inch to 5 miles. (A similar map above Cairo in course of preparation.)	.....	.....	.....

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Preliminary map of the Mississippi River, mouth of the Ohio to Head of the Passes, scale 1 inch to 1 mile, in 32 sheets and 3 index sheets and table of distances; map of the Mississippi River above Cairo, scale 1 inch to 1 mile (published to Keithsburg, Ill., 18 sheets).	.....	.....	.....
Charts of the Mississippi River, Cairo to Donaldsonville, scale 1:20,000, 67 sheets and 2 index sheets. (To be continued to Head of Passes in 14 sheets.)	.....	.....	.....
Charts of the Mississippi River above Cairo, scale 1:20,000 (published to Keithsburg, Ill., 43 sheets).	.....	.....	.....
NAVIGATION.			
Routes, head waters to St. Louis, and Cairo to New Orleans.....	Chief of Engineers	1875, pt. 2	434 496
Routes connecting Mississippi River at New Orleans and other ports.	The Mississippi and its forty-four navigable tributaries, with 3 pls., by Alex. D. Anderson, Washington, 1890, 2 maps, opp. p. 34.	.....	.....
Extent of navigation on Mississippi River and tributaries, 16,090 miles.	The Mississippi and its forty-four navigable tributaries, with 3 pls., by Alex D. Anderson, Washington.	1890	10
Canals, map showing existing and proposed, connected with Mississippi River.	The Mississippi and its forty-four navigable tributaries, with 3 pls., by Alex. D. Anderson, Washington, D. C., opp. page 5.	.....	.....
Boats, with dimensions, arriving at St. Louis, tables, Major Miller.	Chief of Engineers.....	1890 1891 1892	1985 2105 1732
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Report on plans of, for relief of Lower Mississippi River, no relief to be expected from artificial, U. S. Levee Commission.	Chief of Engineers.....	1875	541
Plan of, for relief of Lower Mississippi River, not recommended by U. S. Levee Commission.	.....do	1875, pt. 1	548
Arguments against, as a plan of river improvement.....	"The Mississippi River, what it needs and why it needs it," by Capt. S. S. Leach, Washington, 1890, pp. 5–7.	.....	.....
Views of Judge Taylor and others, expressed before Congressional committee, Mr. Burrows, chairman.	House Report No. 3598, Fifty-first Congress, second session (to accompany H. R. 12168), Jan., 1891.	.....	.....
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Captain Cowdon's statement before select committee, U. S. Senate, General Logan, chairman.	Senate Report No. 36, Forty-eighth Congress, first session, p. 96; Jan., 1884; map 104.	.....	.....
Captain Cowdon's statement before House select committee, Mr. J. C. Burrows, chairman.	House Report No. 1985, Forty-seventh Congress, second session, p. 291; map 308; Feb., 1883.	.....	.....
Hearings before Senate Committee on Commerce, testimony of General Comstock, Colonel Suter, Captain Cowdon, and others.	U. S. Senate Committee on Commerce, hearings in relation to improvements of the Mississippi River; May, 1890.	.....	.....

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Restricting flood heights on the Lower Mississippi River, by means of, Captain Millis. Mississippi River Commission pamphlet, 1894.	.....	.....	.....
Lake Borgne, report of House Select Committee, recommended by a minority of the committee, J. C. Burrows, chairman.	House Report No. 1985, Forty-seventh Congress, second session, Feb. 1883.	.....	.....
Crevasses:			
Bonnet Carre, soundings near, 1849 to 1874, Levee Board...	Chief of Engineers.....	1875, pt. 1.	541
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Nita and others, Captain Kingman on effect of, on the river surface.	U. S. Senate Committee on Commerce, hearings in relation to improvement of the Mississippi River, May, 1890.	.....	.....
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Arguments in favor of, on Mississippi River, with proportion of loss to length of line in recent floods.	"The Mississippi River, What it Needs and Why it Needs it," by Capt. S. S. Leach, Washington, 1890, pp. 7-12.	.....	.....
Effects of a permanent system below Cairo, Low Water Board report.	Chief of Engineers.....	1879	1015
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Levees of the Mississippi River, report of Committee on Levees and Improvements, Mr. Burrows chairman; contains views of members, Mississippi River Commission, and others.	House Report No. 3598 Fifty-first Congress, second session, (to accompany H. R. 12163), Jan., 1891.	.....	.....
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Special report of Mississippi River Commission upon, November 29, 1890.	House Report No. 3598, Fifty-first Congress, second session.	.....	.....
Relative heights of levees, high waters, and ground, from Commerce, Mo., to the Louisiana line, Levee Board, 1874, Commissioner J. E. Sickels.	Chief of Engineers.....	1875, pt. 1.	664
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Length and distribution of main front levees, Alton to Forts; total length in Alluvial Valley, 1,294 miles, Captain Powell.	Chief of Engineers.....	1890.	3111
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Levee profiles and high water slopes, 1882 and 1890, third district, pls. 11 and 12, opp. 3289.	.....do	1890	3288
Levees, third district, built and enlarged by the United States from 1882 to May 31, 1894, tables giving location, cubic contents, cost, etc.	....d.o	1894	2956
Report on levee survey, White River front.....	.....do	1891	3612
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Table of length and condition.....	.....do	1892	3236
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Rainfall, 1874, Mississippi and tributary valleys, tables, Levee Board; also precipitation charts of Signal Service, February to May, 1874, 4 pls.	Chief of Engineers.....	1875, pt. 1.	571
Rainfall at dam above St. Paul, 1885-1893, tables.....	.....do	1894	1705, 1707
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At head waters of Mississippi River, report of Board of Engineers, May 24, 1887.	Chief of Engineers.....	1887	1681
At head waters of Mississippi River and tributaries, history and results to 1887, Major Jones.	.....do	1892	1824
At head waters, capacities, areas, etc., table.....	.....do	1894	1704
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In valley of Red River, report by Charles M. Fauntleroy to the Levee Board.	.....do	1875, pt. 1.	616
Influence of the basins of the Mississippi River on flood heights, Captain Townsend, Mississippi River Commission pamphlet, 1895 (to be printed in Annual Report, 1895).			
SLOPE OBSERVATIONS. (See also Gauges and high waters.)			
High water of 1882, revised table of regimen of Mississippi River, Cairo to the Gulf, Assistant Jones.	Chief of Engineers.....	1890	3123
Vicinity of Ames crevasse. Low water, Kaskaskia to Alton..	.....do	1890, 1891	3184, 3713
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Keithsburg to Alton.....	.....do	1894	2757
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Columbus, New Madrid, Helena, Arkansas City, and Wilson Point, 1893, tabulated results.	.....do	1894	2845
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Alluvial lands, area of Mississippi River and tributaries, 41,193 square miles.	The Mississippi and its forty-four navigable tributaries, with 3 pls., by Alex. D. Anderson, Washington.	1890	23
Crops, cotton, sugar, and corn in alluvial basin Mississippi River since 1840, Levee Board.	Chief of Engineers	1875, pt. 1.	629
Drainage area of Mississippi River and tributaries	The Mississippi and its forty-four navigable tributaries, with 3 pls., by Alex. D. Anderson, Washington.	1890	9
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"A subject index to the professional papers contained in the Annual Reports, in the bulletins, and in the occasional publications of the U. S. Coast and Geodetic Survey from 1815 to 1890, inclusive."	U.S. Coast and Geodetic Survey.	1891, pt. 2.	377
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APPENDIX 4 H.

Index of discharge observations published in U. S. Official Reports, 1889 to 1894.

MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES AND ATCHAFALAYA RIVER.

[For index to earlier publications, see Report Chief of Engineers, 1889, p. 2632 et seq. References marked thus * are to results of final reduction at office of the secretary Mississippi River Commission.]

River.	Locality.	Period.	Number of observations	Report on observations, Chief of Engineers.		Tabulated results, Chief of Engineers.		Authority.
				Year.	Page.	Year.	Page.	
Arkansas	Pine Bluff, Ark	Feb. 20 to July 5, 1879	108			1894	2852	Maj. C. R. Suter.
Do	Little Rock, Ark	May 23 to 24, 1892	2	1893	3681	1893	*3694	Miss. Riv. Com., 2d dist., officer and secretary.
Do	do	May 6, 1893	1			1893	3761	Miss. Riv. Com., 3d dist. officer and secretary.
Do	do	May 6 to 10, 1893	5	1894	2818	1894	*2840	Do.
Atchafalaya	Simmesport, La	Jan. 17 to May 28, 1889	23	1891	3516	1891	*3521	Miss. Riv. Com., 4th dist. officer.
Do	do	Mar. 6 to May 19, 1890	14	1890	3312	1890	3313	Do.
Do	do	do	14			1891	*3540	Do.
Do	do	May 12, 1890	1	1891	3686	1891	3686	Do.
Do	do	Apr. 11, 1891	1			1891	3686	Do.
Do	do	Mar. 9 to Apr. 27, 1891	15	1891	3701	1891	3704	Do.
Do	do	do	15	1892	3126	1892	*3137	Do.
Do	do	Oct. 16 to Nov. 20, 1891	3	1892	3126	1892	*3137	Do.
Do	do	Oct. 16 to 22, 1891	2	1892	3215	1892	3215	Do.
Do	do	Maximum, 1890 and 1891	2			1891	3686	Do.
Do	do	Apr. 1 to June 8, 1892	16			1892	3249	Do.
Do	do	Apr. 1 to June 28, 1892	25	1893	3680	1893	*3692	Do.
Do	do	Oct. 16, 1892	1			1893	3819	Do.
Do	do	Oct. 1 to 16, 1892	12			1893	3910	Do.
Do	do	May 27 to July 11, 1893	17	1894	2824	1894	*2839	Do.
Bayou Bartholomew	Browns Bridge, Arkansas	June 10, 1892	1			1893	3701	Miss. Riv. Com., 3d dist. officer.
Bayou Bartholomew (into).	Head of	June 11 to 13, 1892	1	1893	3668	1893	3701	Do.
Bayou des Glaises	Hamburg, La	April 4, 1882	1			1891	*3488	Miss. Riv. Com., secretary.
Bayou Lafourche	Donaldsonville, La	Feb. 21, 1890	1			1890	3314	Miss. Riv. Com., 4th dist. officer.
Do	do	do	1			1891	*3540	Do.
Bayou Teche	St. Martinsville Bridge	1886		1889	1518	1889	1518	Captain Fisk.
Big Sandy	Louisa, Ky	1891		1892	2105	1892	2103	Major Lockwood.
Black	Near mouth, Louisiana	July 18 to 27, 1891	9			1893	1989	Capt. J. H. Willard.
Do	do	Dec. 21, 1891	1			1893	1989	Do.
Do	do	Mar. 14, 1893	1			1893	1991	Do.
		1890	3			1892	1636	U. S. E. survey.

Crow Wing	*Crow Wing, Wis*	*Oct., 1881, to Oct., 1882*		1892	1827	1892	1827		Major Jones.
Current	*Van Buren, Mo*	Low water	1			1891	2066		Capt. H. S. Taber.
Do	*do*	*do*	1			1893	2128		Do.
Cypress Bayou	*Various, Texas and Louisiana*	1890, 1891	10			1893	2082		Capt. J. H. Willard.
Des Plaines	Upper	Feb., 1887	5			1891	2620		Captain Marshall.
Great Kanawha	Charlestown	1875, 1878, 1881	12	1892	2053	1892	2053		Captain Craighill.
Illinois	Kampsville, Ill	1889	7			1890	2443		Captain Marshall.
Do	do	Oct. 18 to 20, 1891	4			1892	2263, 2266		Do.
Do	La Grange, Ill	1887, 1888, 1889	17			1890	2443		Do.
Do	La Grange Lock, Illinois	Jan. 18, 1890	1			1890	2443		Do.
Do	Ottawa, Ill	1889	66			1890	2536		Do.
Do	Peru, Ill	1889	72			1890	2537		Do.
Illinois and Michigan Canal.	Chicago, Ill					1893	2796		Do.
Kanawha. (See Great Kanawha.)									
Minnesota	At mouth	Sept. 27, 1889, to Mar. 13, 1890	15	1890	2089	1890	2101		Major Jones.
Do	do	Oct. 16 to Nov. 28, 1890	5	1891	2214	1891	2215		Do.
Mississippi	Amos Ridge	Overflow 1890, 1891, 1892, 1893	4			1893	3760		Miss. Riv. Com., 3d dist. officer.
Do	do	Overflow May 28, 1891	2			1891	3133		Do
Do	Arkansas City, Ark	Mar. 22 to 26, 1887	6			1890	*3164		Do.
Do	do	do	6			1891	*3489		Do.
Do	do	Jan. 22 to May 1, 1889	75	1890	3165	1890	*3167		Do.
Do	do	do	75	1891	3490	1891	*3492		Do.
Do	do	Mar. 14 to Apr. 15, 1890	14	1890	3276	1890	3277		Do.
Do	do	do	14			1891	3537		Do.
Do	do	Mar. 9 to 24, 1891	15	1891	3658	1891	3658		Do.
Do	do	Mar. 25 to May 12, 1891	34	1891	3660	1891	3662		Do.
Do	do	Mar. 6 to May 12, 1891	53	1892	3123	1892	*3132		Do.
Do	do	Apr. 23 to May 21, 1892	23	1892	3190	1892	3190		Do.
Do	do	Apr. 22 to July 1, 1892	61	1893	3677	1893	*3686		Do.
Do	Arkansas City, Ark. (overflow west of).	May 28 to 31, 1892	2	1893	3667	1893	3701		Do.
Do	Arkansas City, Ark	May 27, 1893	1			1893	3761		Do.
Do	do	March 9 to June 7, 1893	86	1894	2822	1894	*2829		Do.
Do	do	do	71			1894	a 2949		Do.
Do	Baton Rouge, La	April 26, 1890	1			1890	3314		Miss. Riv. Com., 4th dist. officer.
Do	do	do	1			1891	*3538		Do.
Do	Cairo, Ill	November 11, 1891	1	1892	3120	1892	*3127		Miss. Riv. Com., 1st dist. officer.
Do	Carrollton, La	February 22 to May 28; November 14 to December 12, 1889.	94	1891	3522	1891	*3523		Miss. Riv. Com., 4th dist. officer.
Do	do	March 3 to May 14, 1890	41			1890	3314		Do.
Do	do	February 26 to May 14, 1890	45			1891	*3541		Do.
Do	do	March 4 to April 16, 1890	35			1891	3715		Do.
Do	do	do	43	1892	3126	1892	*3138		Do.
Do	do	Maximum, 1890 and 1891	2			1891	3686		Do.
Do	do	May 14 to June 14, 1892	13			1892	3249		Do.
Do	do	May 14 to June 30, 1892	17	1893	3680	1893	*3693		Do.
Do	do	June 3 to July 3, 1893	35			1894	*2842		Do.

a Comparison with Wilson Point.

Index of discharge observations published in U. S. Official Reports, 1889 to 1894—Continued.

MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES AND ATCHAFALAYA RIVER—Continued.

River.	Locality.	Period.	Number of observations.	Report on observations, Chief of Engineers.		Tabulated results, Chief of Engineers.		Authority.
				Year.	Page.	Year.	Page.	
Mississippi	Chicot, Ark	June 28 to July 2, 1892	8	1893	3677	1893	*3685	Miss. Riv. Com., 3d dist. officer.
Do	Columbus, Ky	February 28 to July 2, 1879	90	1894	2856	1894	2849	Lieut. Col. C. R. Suter.
Do	do	February 27 to March 25, 1891	19	1892	3118	1892	*3127	Miss. Riv. Com., 1st dist. officer.
Do	do	April 13 to 30, 1892	8	1893	3664	1893	*3682	Do.
Do	do	February 20 to May 20, 1893	24	1894	2821	1894	*2825	Do.
Do	Crow Wing, Wis	Oct. 1881, to Oct., 1882	.....	1892	1827	1892	1827	Major Jones.
Do	Elmot, Ark	Jan. 6 to Nov. 11, 1891	12	1892	3120, 3121	1892	*3128	Miss. Riv. Com., 1st dist. officer.
Do	do	See also Plum Point Reach.						
Do	Fulton, Tenn	Maximum, 1882 and 1890	2	.....	.....	1890	3220	Do.
Do	do	Apr. 1, 1891	1	1892	3118, 3122	1892	*3129	Do.
Do	do	Apr. 15, to May 3, 1872	15	1893	3664, 3676	1893	*3683	Do.
Do	do	Feb. 24 to May 23, 1893	17	1894	2822	1894	2827	Do.
Do	Hay Landing, Mississippi	Feb. 18, 1884	1	.....	.....	1891	3488	Miss. Riv. Com., secretary.
Do	Helena, Ark	Nov. 28, 1888 to May 2, 1889	122	1890	3158	1890	3160	Miss. Riv. Com., 2d dist. officer.
Do	do	do	122	1891	3505	1891	3508	Do.
Do	do	Apr. 3, to 23, 1890	14	1890	3217	1890	3219	Do.
Do	do	Apr. 3 to 23; Dec. 23 to 27, 1890	19	1891	3522	1891	*3536	Do.
Do	do	Maximum, 1882 and 1890	2	.....	.....	1890	3220	Do.
Do	do	Mar. 11 to Nov. 11, 1891	63	1892	3119, 3122	1892	*3130	Do.
Do	do	Apr. 18 to June 22, 1892	36	1893	3664, 3676	1893	*3684	Do.
Do	do	May 9 to June 5, 1893	31	1894	2822	1894	*2828	Do.
Do	Henry Clay avenue	See Carrollton, La.						
Do	Lake Providence Reach	Maximum, 1882, 1890, 1891, and 1892.	4	.....	.....	1893	3760	Miss. Riv. Com., 3d dist. officer.
Do	do	See also Hay Landing, Louisiana Bend, and Wilson Point.						
Do	Louisiana Bend	Oct. 19, 1891	1	1892	3125	1892	*3135, 3189	Do.
Do	Memphis, Tenn	Mar. 17 to Apr. 1, 1890	11	.....	.....	1890	3218	Miss. River Com., 2d dist. officer.
Do	do	do	11	1891	3532	1891	3535	Do.
Do	do	Maximum, 1882 and 1890	2	.....	.....	1890	3220	Do.
Do	do	Mar. 6 to Oct. 21, 1891	21	1892	3118, 3122	1892	*3129	Do.
Do	do	Oct. 25, 1892	1	.....	.....	1893	3718	Do.
Do	do	do	1	.....	.....	1894	*2858	Do.
Do	Natchez, Miss	Mar. 17, 1890	2	.....	.....	1890	3313	Miss. River Com., 4th dist. officer.
Do	do	do	2	.....	.....	1891	*3538	Do.
Do	do	Mar. 24 to Apr. 16, 1891	21	.....	.....	1891	3703	Do.
Do	do	do	21	1892	3125	1892	*3136	Do.
Do	do	Maximum, 1890 and 1891	2	.....	.....	1891	3686	Do.
Do	do	May 16 to June 7, 1892	17	.....	.....	1892	3248	Do.
Do	do	May 16 to June 30, 1892	33	1893	3679	1893	*3690	Do.

Do	New Madrid, Mo	Nov. 28, 1888, to May 2, 1889	125	1890	3150	1890	3153	Miss. River Com., 1st dist. officer.
Do	do	do	125	1891	3497	1891	3501	Do.
Do	do	Mar. 25 to Apr. 14, 1890	5			1890	*3157	Do.
Do	do	do	5			1890	3218	Do.
Do	do	do	5			1891	*3531	Do.
Do	do	Maximum, 1882 and 1890	2			1890	3220	Do.
Do	do	Feb. 20 to May 20, 1893	43	1894	2821	1894	*2826	Do.
Do	New Orleans, La	See Carrollton.						
Do	Passes, Louisiana	1877 to 1894	28			1894	1345, 1347	Major Quinn.
Do	Plum Point Reach, Louisiana	Mar. 7 to 15, 1890	4			1890	3218	Miss. Riv. Com., 1st dist. officer.
Do	do	do	4	1891	3532	1891	3534	Do.
Do	do	See also Elmot and Fulton.						
Do	Red River Landing, La	Jan. 10 to May 29, 1889	62	1891	3516	1891	*3518	Miss. Riv. Com., 4th dist. officer.
Do	do	Feb. 21 to May 20, 1890	21			1890	3313	Do.
Do	do	Feb. 22 to May 20, 1890	20			1891	*3539	Do.
Do	do	Mar. 10 to Apr. 20, 1891	12			1891	3703	Do.
Do	do	do	12	1892	3125	1892	*3137	Do.
Do	do	Oct. 15 to Nov. 22, 1891	5	1892	3125	1892	*3137	Do.
Do	do	do	5			1892	3215	Do.
Do	do	Maximum, 1890 and 1891	2			1891	3686	Do.
Do	do	Apr. 3 to June 7, 1892	15			1892	3248	Do.
Do	do	Apr. 3 to June 27, 1892	23	1893	3679	1893	*3691	Do.
Do	do	May 23 to July 10, 1893	32	1894	2823	1894	*2837	Do.
Do	Rock Island Rapids	1880	2	1889	1758	1889	1758	Major Mackenzie.
Do	St. Francis Basin	Mar. 17 to Apr. 3, 1890	4			1890	3217	Miss. Riv. Com., 2d dist. officer.
Do	do	do	4			1891	3546	Do.
Do	St. Louis, Mo	May 20 to 21, 1892	2	1893	3675	1893	*3682	Miss. Riv. Com. secretary.
Do	St. Paul, Minn	Sept. 20, 1889 to Mar. 21, 1890	36	1890	2099	1890	2101	Major Jones.
Do	do	Oct. 1, 1890, to June 30, 1891	57	1891	2214	1891	2215	Do.
Do	do	July 1, 1891, to June 30, 1892	135	1892	1849	1892	1850	Do.
Do	do	July 1, 1892, to June 30, 1893	87	1893	2289	1893	2289	Do.
Do	do	July 1, 1893, to June 30, 1894	159	1894	1732	1894	1733	Do.
Do	Warrenton, Miss	Mar. 12 to May 1, 1889	57	1891	3512	1891	*3513	Miss. Riv. Com., 4th dist. officer.
Do	do	Mar. 4 to Apr. 12, 1890	6			1890	3313	Do.
Do	do	do	6			1891	*3538	Do.
Do	do	Maximum, 1890	1			1891	3686	Do.
Do	Waterproof Cut-off	May 25, July 23, 1884	2			1891	*3488	Do.
Do	Wilson Point, La	Nov. 27, 1883, to Mar. 13, 1885	49	1890	3170	1890	*3173	Miss. Riv. Com., 3d dist. officer.
Do	do	Apr. 19, 1887	1			1890	*3174	Do.
Do	do	do	1			1891	*3496	Do.
Do	do	Apr. 22 to 27, 1888	6			1890	*3174	Do.
Do	do	do	6			1891	*3496	Do.
Do	do	July 3 to 5, 1889	3			1890	*3174	Do.
Do	do	do	3	1891	3497	1891	*3496	Do.
Do	do	Jan. 28 to May 7, 1890	70	1890	3170	1890	*3175	Do.
Do	do	do	70	1890	3281	1890	3281	Do.
Do	do	do	70	1891	3526	1891	*3527	Do.
Do	do	Dec. 28 to 30, 1890	3	1891	3658	1891	3659	Do.
Do	do	do	3			1892	*3144	Do.
Do	do	Mar. 27 to May 7, 1891	33	1891	3658	1891	3659	Do.

Index of discharge observations published in U. S. Official Reports, 1889 to 1894—Continued.

MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES AND ATCHAFALAYA RIVER—Continued.

River.	Locality.	Period.	Number of observations.	Report on observations. Chief of Engineers.		Tabulated results. Chief of Engineers.		Authority.
				Year.	Page.	Year.	Page.	
Mississippi	Wilson Point, La	Mar. 27 to May 7, Oct. 16 to Nov. 12, 1891.	38	1892	3123	1892	*3134	Miss. Riv. Com., 3d dist. officer.
Do	do	Oct. 16 to Nov. 12, 1891	4			1892	3189	Do.
Do	do	Apr. 16 to May 19, 1892	27	1892	3188	1892	3189	Do.
Do	do	Apr. 16 to May 20, Oct. 26 to Nov. 22, 1892.	62	1893	3678	1893	*3698	Do.
Do	do	May 24, 1893	1			1893	3761	Do.
Do	do	Mar. 7 to June 8, 1893	89	1894	2822	1894	*2833	Do.
Do	do	do	71			1894	a 2949	Do.
Do	do	Oct. 24, 1893	2			1894	(2834) (2836)	Do.
	Second district.							
Mississippi (crevasses)	Austin	Apr. 3, 1890	1			1891	3536	Miss. Riv. Com., 2d dist. officer.
Do	do	do	1			1892	3144	Do.
Do	Robertsonville	Apr. 14, 1891	1	1892	3119 '23	1892	*3131	Do.
	Third district.							
Mississippi (crevasses)	Arkansas City (near)	1890	8	1890	3262	1890	3262	Miss. Riv. Com., 3d dist. officer.
Do	Brooks Mills	May 13, 1892	1	1892	3186	1892	3131	Do.
Do	Concord	Apr. 18, 1891	1	1891	3413	1891	3414	Do.
Do	do	do	1			1892	3135	Do.
Do	Panther Forest	May 17, 1892	1	1892	3186	1892	3186	Do.
Do	Raleigh	1890	1	1890	3269	1890	3269	Do.
Do	Skipwith	Apr. 2 to May 6, 1890	10	1890	3281	1890	*3178, 3282	Do.
Do	Stella	1891		1891	3413	1891	3414	Do.
Do	Easton, Huntington, Luna, Columbia, Point Chicot, Skipwith, and others.	Mar. 12 to May 6, 1890	56	1890	3276	1890	3278	Do.
						1891	3543	Do.
Do	Fulton, Panther Forest, Columbia, Leland, Brooks Mills.	1892	14	1893	3678	1893	3702	Do.
Do	Arkansas City, Panther Forest, Upper Leland, Lower Leland, Brooks Mills.	1893	5			1893	3760	Do.
Do	Lakeport, Keigers, Grand Lake, Wylys, Cypress.	1893	12			1894	2844	Do.
						1894	2953	Do.

	Fourth district.							
Mississippi (crevasses)	Ames	1891		1891	3684	1891	3684	Miss. Riv. Com., 4th dist. officer.
Do	Ferriday	1891		1891	3685	1891	3685	Do.
Do	Henderson	1891		1891	3685	1891	3685	Do.
Do	Harlem, Nita, Live Oak, Myrtle Grove, Lake Concordia, Henderson-Ashley, Upper Morganza, New Morganza, Fanny Richie, Lobdell, and others.	Mar. 23 to May 23, 1890	22	1890	3338	1890	3338	Do.
				1890	3293			Do.
						1891	3545	Do.
Do	Ascension, New Hope, Belmont, Tessier, Anchor, Sarpy, Harlem, and others.	July 8 to 12, 1892	25			1893	3702	Do.
						1893	3848	Do.
Missouri	Sioux City and above	Aug. 15 to Nov. 15, 1893	24	1894	1769	1894	1744	Captain Hodges.
Do	Sioux City, Iowa	Jan. 10 to Apr. 24, 1894	14			1894	1745	Do.
Do	Grand Fork to Canyon Ferry	Low water				1894	1780	Do.
Ohio	Cairo, Ill	Nov. 11, 1891	1	1892	3120	1892	*3127	Miss. Riv. Com., 1st dist. officer.
Do	Davis Island to Tennessee River.	Oct. 7 to Nov. 24, 1892	16	1893	2456	1893	2459	Lieutenant-Colonel Stickney.
Old	One-fourth mile above mouth	Jan. 9 to 16, 1882	3			1891	*3488	Miss. Riv. Com. secretary.
Do	Turnbull Island (below)	Jan. 22 to May 27, 1889	15	1891	3516	1891	*3520	Miss. Riv. Com., 4th dist. officer.
Osage	Brennecks and Burds Shoals	May 8 to Nov. 25, 1891	172	1892	1743			Maj. A. M. Miller.
Ouachita	Camden and Monroe	May, 1892	3			1893	2095	Capt. J. H. Willard.
Do	Harrisonburg, La	August, 1890	2	1891	1968	1891	1968	Do.
Do	Monroe, La	May 30 to June 1, 1892	2	1893	3681	1893	*3694	Capt. S. W. Roessler.
Red *b*	Alexandria, La	Feb. 24 to July 1, 1879	98	1894	2856	1894	2854	Maj. W. H. H. Benyaurd.
Do	....do	June 13 to Nov. 17, 1891	68			1893	1988	Capt. J. H. Willard.
Do	....do	May 26 to June 15, 1892	17	1893	3681	1893	*3695	Miss. Riv. Com., 3d dist. officer and secretary.
Do	Alexandria, La	June 10 to 15, 1892	5			1893	1990	Capt. J. H. Willard.
Do	....do	Mar. 7, 1893	1			1893	1991	Do.
Do	Red River dam	Oct. 22 to Nov. 6, 1891	4	1892	3215	1892	3215	Mis. Riv. Com., 4th dist. officer.
Do	Shreveport, La	Feb. 23 to 28, 1891	3			1893	1986	Capt. J. H. Willard.
Do	....do	May 30 to June 6, 1892	4			1893	1990	Do.
Do	....do	Feb. 11, 1893	1			1893	1990	Do.
Do. and tributaries	Various	Aug. 26 to Nov. 25, 1893	21	1894	1440	1894	1448	Do.
Rock	Carrs Island	Sept. 1 to 25, 1891	9	1892	2301	1892	2302	Capt. W. L. Marshall.
Do	Near mouth					1891	2647	Do.
St. Croix	Taylors Falls	Oct. 1881 to Nov. 1882		1892	1827	1892	1827	Maj. W. A. Jones.
Tennessee	Various	1891 and 1892	9			1893	2366	Captain Biddle.
White	Clarendon, Ark	Feb. 5 to June 20, 1879	65	1894	2857	1894	2855	Maj. W. H. H. Benyaurd.
Do	....do	May 19 to 28, 1892	9			1894	*2858	Mis. Riv. Com., 1st and 2d dist. officer and secretary.
Do	....do	May 10, 1893	1			1893	3761	Mis. Riv. Com., 3d dist. officer and secretary.
Do	....do	May 5 to 10, 1893	5	1894	2819	1894	*2840	Do.
Yazoo	Various	1858 to 1890	16			1892	1636	Capt. J. H. Willard, compiler.
Do	....do	Oct. 22, 1892, to May 26, 1893	9			1893	2036	Capt. J. H. Willard.

a Comparison with Arkansas City.

b In Chief of Engineers, 1893, pages 1986 to 1991 are published numerous other observations at various points on the Red River and its tributaries and outlets.

APPENDIX 4 I.

Results of discharge observations, Mississippi River, 1894.

ASHPORT BEND, 153 MILES BELOW CAIRO.

[Observations and reductions made under direction of the district officers, Mississippi River Commission. Meter run at six-tenths depth; lower float run at six-tenths depth.]

Date.	Gauges.			Cross section of discharge.						Mean velocity per second.	Discharge per second.	Method.	No. of velocity stations.	No. of soundings.	Direction and force of wind.
	Standard.	Local.	Rise or fall in preceding 24 hours.	Area.		Depth.		Width.	Scour or fill.						
				Water.	Below datum.	Mean.	Maximum.								
1894.	*Feet.*	*Feet.*	*Feet.*	*Sq. ft.*	*Sq. ft.*	*Feet.*	*Feet.*	*Feet.*	*Sq. ft.*	*Feet.*	*Cu. ft.*				
November 8	*a* 1.8	—2.1	0.0	38,050	.....	35.9	66	1,059	.....	2.174	82,730	Floats...	11	24	
10	*a* 1.9	—2.1	+0.1	38,421	.....	36.6	66	1,051	.....	2.135	82,065	Floats...	9	16	
MEMPHIS, TENN., 230 MILES BELOW CAIRO.															
November 8	*b* —1.40	.....	0.0	57,077	.....	38.4	75	1,486	.....	1.471	83,998	Floats...	12	16	XI—slight.
10	*b* —1.30	.....	—0.1	57,628	.....	38.8	75	1,486	.....	1.463	84,320	Floats...	10	15	IX—fresh.
OLD TOWN BEND, 325 MILES BELOW CAIRO.															
November 8, a. m.	*c* —2.2	.....	—0.1	50,174	.....	28.8	52.5	1,745	.....	1.528	76,677	Meter...	13	62	
8, p. m	*c* —2.2	.....	—0.1	50,168	.....	28.7	52.5	1,745	.....	1.753	87,966	Meter...	12	63	
9	*c* —2.2	.....	0.0	50,260	.....	28.8	52.5	1,745	.....	1.752	88,063	Meter...	13	71	
VICINITY OF GREENVILLE, MISS., 478 MILES BELOW CAIRO.															
April 19, a. m. *d*	*e* 28.10	.....	0.0	138,721	.....	39.2	94	3,538	.....	5.27	*f* 740,233	Meter...	12	52	
19, p. m. *g*	*e* 28.15	.....	0.0	177,906	.....	34.0	63.5	5,232	.....	3.77	671,236	Meter...	18	72	
November 20 *h*	*e* —0.50	.....	—0.1	36,293	.....	13.1	21.5	2,754	.....	2.859	103,771	Meter...	14	55	
WILSON POINT, MISS., 530 MILES BELOW CAIRO. *i*															
September 26	*j* 1.0	2.32	0.0	43,926	.....	17.1	27.5	2,571	.....	3.99	175,055	Meter...	13	51	
27	*j* 1.0	2.31	0.0	44,893	.....	17.5	27.5	2,571	.....	3.95	177,371	Meter...	13	51	

a Fulton.
b Memphis.
c Helena.
d Section about 2½ miles above Greenville.
e Greenville.
f This includes discharge of chute, 9,604 cubic feet per second.
g Section about 5 miles below Greenville.
h Section about 3 miles below Greenville.
i Section is opposite Skipwith Towhead.
j Lake Providence.

APPENDIX 4 J.

Highest and lowest gauge readings for each year, 1891 to 1894, referred to present gauges, Mississippi River and principal tributaries.

[NOTE.—For earlier years, see Report Chief of Engineers 1891, pp. 3555–3575.]

MISSISSIPPI RIVER, HASTINGS, MINN. (883 MILES ABOVE CAIRO).

[U. S. Engineer gauge; zero, 690.79 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Apr. 26	6.95	Nov. 21–22	—0.65	Previous highest, Apr. 30, 1881, 18 feet; previous lowest, Nov. 28–30, 1889,—0.40 foot.
1892	May 26	13.1	Nov. 23	—0.7	
1893	May 6	14.3	do	0.1	
1894	May 20–21	13.0	Aug. 6	—0.5	

MISSISSIPPI RIVER, WINONA, MINN. (785 MILES ABOVE CAIRO).

[U. S. Engineer gauge; zero, 660.34 feet above the Cairo datum plane.]

1891	Apr. 28	8.79	Nov. 26–27	—0.33	Previous highest, June 18, 1880, 16.87 feet; previous lowest, Dec. 30, 1889, —1.33 feet.
1892	May 26–27	12.1	Nov. 24	1.1	
1893	May 16	12.6	Feb. 12, Nov. 24	1.1	
1894	May 21	13.3	Aug. 10–11	0.4	

MISSISSIPPI RIVER, NORTH McGREGOR, IOWA (679 MILES ABOVE CAIRO).

[U. S Engineer gauge; zero, 625.45 feet above the Cairo datum plane.]

1891	Apr. 28–30	13.0	Nov. 28	0.6	Previous highest, May 13, 1888, 20.60 feet; previous lowest, Dec. 30, 1889, 0.40 foot.
1892	May 31	15.2	Nov. 23	1.1	
1893	May 10–11	15.1	Nov. 27–28	0.9	
1894	May 26	15.3	Aug. 16–17	0.3	

MISSISSIPPI RIVER, HANNIBAL, MO. (322 MILES ABOVE CAIRO).

[Bridge gauge; zero, 469.60 feet above the Cairo datum plane.]

1891	Apr. 23	12.25	Dec. 1	—1.17	Previous highest, May 17, 1888, 21.58 feet; previous lowest, Dec. 2–5, 1886,—0.67 foot; records received from Major Mackenzie.
1892	July 3	20.8	Dec. 21	—1.4	
1893	May 28	16.8	Dec. 3–5	—1.6	
1894	June 4–6	12.1	Dec. 31	—0.8	

MISSISSIPPI RIVER, GRAFTON, ILL. (220 MILES ABOVE CAIRO).

[U. S. Weather Bureau gauge; zero, 424.09 feet above the Cairo datum plane.]

1891	Apr. 26	14.93	Feb. 7	0.07	Previous highest, June 25, 1883, 23.33 feet; previous lowest, Dec. 4, 1886, Dec. 28, 1887, —0.07 foot. U. S. Engineer gauge until 1892.
1892	May 18	25.73			
1893					
1894	May 12	14.3	Aug. 29, Sept. 4	0.8	

MISSISSIPPI RIVER, ST. LOUIS, MO. (181 MILES ABOVE CAIRO).

[U. S. Engineer gauge; zero, 400.23 feet above the Cairo datum plane.]

1891	July 4	23.78	Dec. 3	2.60	Previous highest, June 28, 1844, 41.4 feet; previous lowest, Dec. 21, 1863, 0.0 foot.
1892	May 19	35.95	Dec 24	1.10	
1893	May 3	31.60	Dec. 8–9	0.10	
1894	May 11	23.70	Feb. 3	0.20	
			Dec. 31	1.00	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

MISSISSIPPI RIVER, CHESTER, ILL. (108 MILES ABOVE CAIRO).

[U. S. Weather Bureau gauge; zero, 361.30 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	June 11	18.2	Dec. 5-7, 12-13	0.9	
1892	May 21	31.2	Jan. 15	—1.8	
1893	May 4	28.4			
1894	May 12	18.0	Dec. 31	0.0	No record for January or February, 1894.

MISSISSIPPI RIVER, GRAYS POINT, MISSOURI (45 MILES ABOVE CAIRO).

[Mississippi River Commission gauge; zero, 321.28 feet above the Cairo datum plane.]

1891	Apr. 26	23.10	Dec. 6	4.75	Previous highest, June 27-28, 1883, 34.31 feet; previous lowest, Dec. 31, 1880, 0.91 foot.
1892	May 22	35.00	Dec. 29-30	1.85	
1893	May 4-5	32.50	Jan. 1	2.35	
1894	May 13	22.80	Feb. 3-6	3.70	
			Dec. 31	4.00	

MISSISSIPPI RIVER, BELMONT, MO. (21 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 286.85 feet above the Cairo datum plane.]

1891	Mar. 6-7	41.30	Nov. 7	1.55	Previous highest, Feb. 23-24, 1884, 46.09 feet; previous lowest, Jan. 1, 1888, 1.68 feet.
1892	Apr. 28	43.14	Oct. 28-29	2.68	
1893	May 8-10	43.80	Sept. 5-6	3.95	
1894	Feb. 16	34.15	Nov. 3	0.79	

MISSISSIPPI RIVER, MORRISSONS LANDING, MISSOURI (69 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 275.80 feet above the Cairo datum plane.]

1891	Mar. 7-8	36.40	Nov. 7-8	2.50	Previous highest, Feb. 24, 1884, 41.50 feet; previous lowest, Nov. 11-14, 1879, —0.17 foot. Discontinued Oct. 11, 1893.
1892	Apr. 29	37.68	Oct. 28-29	3.4	
1893	May 10-11	38.70	Jan. 16	4.0	
1894					

MISSISSIPPI RIVER, NEW MADRID, MO. (70 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 275.72 feet above the Cairo datum plane.]

1891					
1892					
1893	May 10	38.11	Jan. 22	4.12	
1894	Feb. 16-18	29.46	Nov. 2	1.67	

MISSISSIPPI RIVER, COTTONWOOD POINT, MO. (123 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 250.62 feet above the Cairo datum plane.]

1891	Mar. 8	35.90	Nov. 7-8	—0.40	Previous highest, Feb. 28, 1883, 37.85 feet; previous lowest, Oct. 24-25, 1889, —0.35 foot.
1892	Apr. 30	36.45	Oct. 29-31	0.40	
1893	May 12-13	36.55	Jan. 17	1.10	
1894	Feb. 17-18	30.55	Nov. 2-7	—1.45	

MISSISSIPPI RIVER, FULTON, TENN. (175 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 228.55 feet above the Cairo datum plane.]

1891	Mar. 13-14	33.90	Nov. 7	2.65	Previous highest, Mar. 1, 1882, 36.69 feet; previous lowest, Jan 3, 1888, 1.60 feet.
1892	Apr. 30	34.27	Oct. 30, Nov. 1	4.72	
1893	May 15	34.63	Jan. 23	4.90	
1894	Feb. 18-19	27.75	Nov. 5-7	1.74	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

MISSISSIPPI RIVER, MEMPHIS, TENN. (230 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 203.97 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Mar. 10	34.90	Nov. 8-9	1.00	Previous highest, Mar. 23-24, Apr. 4-5, 1890, 35.60, feet; previous lowest, Dec. 25, 1872, —0.95 foot.
1892	May 2-3	34.60	Oct. 30-31	1.60	
1893	May 15-16	35.20	Jan. 24	1.80	
1894	Feb. 19-20	29.00	Nov. 6-8	—1.40	

MISSISSIPPI RIVER, MHOON LANDING, MISSISSIPPI (277 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 181.48 feet above the Cairo datum plane.]

1891			Nov. 7-15	1.60	Previous highest, Mar. 8, 1883, 40.20 feet; previous lowest, Oct. 26-31, 1889, 2.20 feet.
1892	May 8-11	36.30	Nov. 1-2	2.2	
1893	May 24-25	37.90	Jan. 23-25	2.6	
1894	Feb. 20-21	30.80	Nov. 6-10	7.24	

MISSISSIPPI RIVER, HELENA, ARK. (306 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 161.98 feet above the Cairo datum plane.]

1891	Mar. 27-28	44.70	Nov. 8	0.85	Previous highest, Apr. 30, 1886, 48.10 feet; previous lowest, Jan. 5, 1888. —0.18 foot.
1892	May 11	45.73	Oct. 31	1.18	
1893	May 25	47.92	Sept. 8	2.65	
1894	Feb. 21	38.07	Nov. 8	—2.23	

MISSISSIPPI RIVER, SUNFLOWER LANDING, MISSISSIPPI (353 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 147.08 feet above the Cairo datum plane.]

1891	Mar. 28-Apr. 1.	40.90	Nov. 9, 14	2.10	Previous highest, Mar. 30-Apr. 1, 1890, 42.90 feet; previous lowest, Aug. 31, 1889, 4.30 feet.
1892	May 11-13, June 1.	41.70	Nov. 1	3.2	
1893	May 28	43	Sept. 8-9	4.50	
1894	Feb. 22	37.30	Nov. 6-8	—.34	

MISSISSIPPI RIVER, MOUTH OF WHITE RIVER, ARKANSAS, (393 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 128.73 feet above the Cairo datum plane.]

1891	Apr. 5	47.72	Nov. 14-15	4.78	Previous highest, Mar. 31, 1890, 50.40 feet; previous lowest, Dec. 28, 1872, 0.00 foot.
1892	June 1	49.27	Oct. 27	6.50	
1893	May 29	49.48	Oct. 26	7.80	
1894	Feb. 23	42.12	Nov. 7-8	2.65	

MISSISSIPPI RIVER, ARKANSAS CITY, ARK. (438 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 116.44 feet above the Cairo datum plane.]

1891	Apr. 3-7	48.2	Nov. 10-17	0.5	Previous highest, Mar. 27, 1890, 49.50 feet; previous lowest, Nov. 24, 1887, 0.30 foot.
1892	June 1	50	Oct. 28	2.10	
1893	May 29	50.30	Oct. 26	3.40	
1894	Feb. 24-25, Mar. 29-30.	40.5	Nov. 8	—2.36	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

MISSISSIPPI RIVER, GREENVILLE, MISS. (478 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 108 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Apr. 2-3	43.25	Nov. 13-16	2.20	Previous highest, Mar. 17-18, 1890, 43.45 feet; previous lowest, Nov. 22-24, 1887, 1.85 feet.
1892	June 1	44.28	Oct. 27-28	2.80	
1893	May 29	44.30	Oct. 26-27, Nov. 17-19, Nov. 30-Dec. 2.	3.40	
1894	Feb. 25	35.40	Nov. 8-9	−1.01	

MISSISSIPPI RIVER, LAKE PROVIDENCE, LA. (542 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 89.62 feet above the Cairo datum plane.]

1891	Apr. 1-4	41	Nov. 13	0.60	Previous highest, Mar. 15, 1890, 41.05 feet; previous lowest, Dec. 29, 1872, 3.85 feet.
1892	June 2	41.9	Oct. 28-29	.70	
1893	May 15-17	41.85	Nov. 19, Dec. 2	.75	
1894	Feb. 25-26	34.40	Nov. 9, 11-12	−4.25	

MISSISSIPPI RIVER, VICKSBURG, MISS. (599 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 66.04 feet above the Cairo datum plane.]

1891	Apr. 2-4	48.10	Nov. 16-18	−2.50	Previous highest, Apr. 24-25, 1890, 49.05 feet; previous lowest, Nov. 24, 1887, −3.91 feet.
1892	June 2-3	48.45	Oct. 30	−1.00	
1893	May 22-23	48.30	Oct. 28-29	.30	
1894	Apr 2	40.90	Nov. 11-14	−5.31	

MISSISSIPPI RIVER, ST. JOSEPH, LA. (648 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 52.74 feet above the Cairo datum plane.]

1891	Apr. 11	43.80	Nov. 15-16	−4	Previous highest, Apr. 23, 1890, 45.15 feet; previous lowest, Nov. 1, 1889, −3.95 feet.
1892	June 3-4	44.55	Nov. 6-7	−2	
1893	May 22-23	44.10	Oct. 29	−1.60	
1894	Apr. 2-3	36.90	Nov. 10-13	−7.74	

MISSISSSIPPI RIVER, NATCHEZ, MISS. (700 MILES BELOW CAIRO).

[U. S. Engineer gauge, zero; 36.89 feet above the Cairo datum plane.]

1891	Apr. 11-12	46.32	Nov. 16, 18-20	3.69	Previous highest, Apr. 23, 1890, 48.60 feet previous lowest, Dec. 14-15, 1872, 0.0 foot.
1892	June 26	48.10	Oct. 29-31	5	
1893	May 22-24	46.80	Oct. 29	6.05	
1894	Apr. 3-4	40.60	Nov. 10-13	1	

MISSISSIPPI RIVER, RED RIVER LANDING, LA. (765 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 23.85 feet above the Cairo datum plane.]

1891	Apr. 26-May 4	45.48	Nov. 12-13	0.90	Previous highest, Apr. 23, 1890, 48.67 feet; previous lowest, Dec. 15, 1872, 0.00 foot.
1892	June 27	48.87	Oct. 31	2.12	
1893	June 25-27	47.72	Oct. 28-31	4.10	
1894	Apr. 5-6	39.50	Nov. 12	− .25	

MISSISSIPPI RIVER, BAYOU SARA, LA. (800 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 23.95 feet above the Cairo datum plane.]

1891	Apr. 29-May 6	38.80	Nov. 10-15	−1.8 (?)	Previous highest, Apr. 21, 1890, 41.20 feet; previous lowest, Nov. 2-5, 1889, −2.10 feet.
1892	June 28	42.25	Oct. 31	− .75	
1893	June 24-25	41.50	Oct. 25	.22	
1894	Apr. 5-7	33.10	Nov. 11-14	−2.73 (?)	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

MISSISSIPPI RIVER, BATON ROUGE, LA. (833 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 20.06 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	May 3–5	35.55	Nov. 8–10–11	1.20	Previous highest, Apr. 21, 22, 1890, 36.60 feet; previous lowest, Jan. 9, 1877, 0.90 foot.
1892	June 28	38.45	Oct. 31	2.50	
1893	June 23	38.40	Sept. 14, Dec. 4–5	2.65	
1894	Apr. 5	30.95	Nov. 14	.45	

MISSISSIPPI RIVER, PLAQUEMINE, LA. (854 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 21.06 feet above the Cairo datum plane.]

1891	Apr. 15–22	31.05	Nov. 13	0.20	Previous highest, Apr. 22, 1890, 31.90 feet; previous lowest, Oct. 28, 1889, 1.55 feet.
1892	June 13	33.50	Oct. 30	.50	
1893	June 23	33.75	Dec. 5, 7	.80	
1894	Apr. 6	26.80	Nov. 14	—.94	

MISSISSIPPI RIVER, DONALDSONVILLE, LA. (885 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 19.48* feet above the Cairo datum plane.]

1891	Mar. 18, 20	27.90	Nov. 6	1.70	Previous highest, Mar. 23, 1884, 28.19 feet; previous lowest, Aug. 21–22, 1890, 4.14 feet.
1892	June 13	30.15	Nov. 9–10	2.30	
1893	June 23	30.60	Dec. 4	1.90	
1894	Apr. 5–6	24.35	Nov. 11	1	

* Preliminary value.

MISSISSIPPI RIVER, COLLEGE POINT, LA. (904 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 21.24 feet above the Cairo datum plane.]

1891	Mar. 16	23.45	Oct. 21	0.00	Previous highest, Mar. 24, 1884, 24.10 feet; previous lowest, Oct. 28, 1889, 0.62 foot.
1892	June 13	25.62	Oct. 27, Nov. 20	.25	
1893	June 23	25.90	Dec. 7	.05	
1894	Apr. 5	20.55	Nov. 14	—.91	

MISSISSIPPI RIVER, CARROLLTON, LA. (957 MILES BELOW CAIRO).

[U. S. Engineer gauge; zero, 20.91 feet above the Cairo datum plane.]

1891	Mar. 16	16	Oct. 21	—0.05	Previous highest, Mar. 13, 17, 1890, 16.10 feet; previous lowest, Dec. 27, 1872, —1.60 feet.
1892	June 10	17.35	Nov. 21	.15	
1893	June 22	17.45	Dec. 8	.30	
1894	Apr. 6	13.50	Nov. 15	—.05	

MISSISSIPPI RIVER, FORT JACKSON, LA. (1,039 MILES BELOW CAIRO).

[Mississippi River Commission gauge; zero, 19.26 feet above the Cairo datum plane.]

1891	Mar. 31	6.9	Nov. 30	0.50	
1892	June 13	6.85	Nov. 20	.5	
1893	June 15	6.70	Dec. 7	.3	
1894	Apr. 8–9	*5.8	Nov. 12, 14	.3	

* Oct. 8 observer reported a storm on the Gulf with an extreme reading of about 8 feet.

ARKANSAS RIVER, LITTLE ROCK, ARK. (176 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 241.55 feet above the Cairo datum plane.]

1891	Apr. 24	22.70	Nov. 12–13	3.90	Previous highest, Feb. 15, 1884, 30.60 feet; previous lowest, Oct. 23–24, 1879, —1 foot.
1892	May 21	31.20	Jan. 17	6.00	
1893	May 3	27.20	Nov. 10–20	4.20	
1894	Mar. 22–23	24.80	Nov. 29–Dec. 2	3.20	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

ARKANSAS RIVER, PINE BLUFF, ARK. (110 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 195.24* feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Apr. 24-25	23.10	Nov. 13	8.55	Previous highest, Feb. 17, 1884, 34.25† feet; previous lowest, Nov. 20-23, 1887, 4.70 feet.
1892	May 22	35.6	Oct. 17-18	7.85	
1893	May 5	33.7	Nov. 19	7.10	
1894	Mar. 24	29.7	Nov. 29-Dec. 1	6.7	

* Preliminary value. † Record doubtful; it may have been higher.

ATCHAFALAYA RIVER, BARBRES LANDING, LOUISIANA (0 MILES FROM HEAD).

[Mississippi River Commission gauge; zero, 24.17 feet above the Cairo datum plane.]

1891	Apr. 25-May 4	45.65	Nov. 7-8	−1.0	Previous highest, Mar. 27, 1882, 49.90 feet; previous lowest, Sept. 18, 1881, −1.20 feet.
1892	June 27-28	49.7	Oct. 25	0.20	
1893	June 26-28	48.70	Nov. 18	0.80	
1894	Apr. 6-7	39.15	Nov. 12	−1.70	

ATCHAFALAYA RIVER, SIMMESPORT, LA. (4 MILES FROM HEAD).

[Mississippi River Commission gauge; zero, 24.17 feet above the Cairo datum plane.]

1891	Apr. 26-May 2	43.32	Nov. 8	−1.60	Previous highest, Apr. 22-23, 1890, 45.50 feet; previous lowest, Oct. 2, 1887, −0.65 foot. Gauge discontinued, 1892.
1892	June 24	46.64			
1893					
1894					

ATCHAFALAYA RIVER, WEST MELVILLE, LA. (27 MILES FROM HEAD).

[U. S. Weather Bureau gauge; zero, 20.17 feet above the Cairo datum plane.]

1891	Apr. 9-May 8	33.7	Nov. 7	1.5	Previous highest, 1882, 37 feet; previous lowest, Sept. 16, 1887, 1.50 feet. Gauge maintained by the Mississippi River Commission, 1887 to 1892, inclusive.
1892	June 25	35.0	Oct. 26-27	2.80	
1893	June 27-30	35.0	Nov. 17-18	3.60	
1894	Apr. 6-7	32.2	Nov. 12-13	1.0	

CUMBERLAND RIVER, NASHVILLE, TENN. (266 MILES FROM CAIRO).

[U. S. Engineer gauge; zero, —— feet above the Cairo datum plane.]

1891	Mar. 14	49.30	Oct. 16-20, Nov. 2-9.	0.00	Previous highest, Jan. 22, 1882, 55.30 feet; previous lowest, Oct. 15-16, 1878, — 0.40 foot.
1892	Apr. 26	38.80	Nov. 1	−0.20	
1893	Feb. 22	40.80	Sept. 8-11, 23-24, Nov. 2-8.	0.60	
1894	Feb. 9	42.30	Oct. 23-24, 29-31.	−0.10	

ILLINOIS RIVER, BEARDSTOWN, ILL. (76 MILES FROM MOUTH).

[U. S. Weather Bureau gauge; zero, 444.26 feet above the Cairo datum plane.]

1891	Apr. 24-28	12.8	Oct. 13-23	5.9	Previous highest, 1882, 21.3 feet; previous lowest, Aug. 11-12, 1887, 0.00 foot.
1892	May 15-16	18.4	Oct. 29-31	6.0	
1893	Mar. 14-15	17.0	Oct. 4-5	5.4	
1894	Mar. 20-24	9.8	Aug. 8-17	5.7	

MISSOURI RIVER, COLES CREEK, MISSOURI (107 MILES FROM MOUTH).

[Missouri River Commission gauge; zero, 433.97 feet above the Cairo datum plane.]

1891	July 3	91.5	Dec. 17	75.26	
1892	May 15	96.76	Jan. 13	73.51	
1893	May 1	91.15	Dec. 8-9	71.85	
1894	May 10	88.8	Feb. 1	72.45	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

OHIO RIVER, CINCINNATI, OHIO (504 MILES FROM MOUTH).

[City water-works gauge; zero, 447.62 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Feb. 25	57.37	Oct. 9–16, Nov. 2	4.5	Previous highest, Feb. 14, 1884, 71.06 feet; previous lowest, Sept. 18, 1881, 1.92 feet.
1892	Apr. 25	43.9	Nov. 5–6	3.5	
1893	Feb. 21	54.58	Aug. 29–30	3.58	
1894	Feb. 15	35.58	Sept. 14–15	3.08	

OHIO RIVER, LOUISVILLE (UPPER), KY. (364 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 419.76 feet above the Cairo datum plane.]

1891	Feb. 27	32.40	Oct. 28–29	2.50	Previous highest, Feb. 16, 1884, 46.60 feet; previous lowest, Sept. 10–14, 18–22, 1881, 1.70 feet.
1892	Apr. 23	21.80	Nov. 8	2.00	
1893	Feb. 21	28.89	Aug. 24–Sept. 4	2.00	
1894	Feb. 14	12.70	Oct. 20	2.00	

OHIO RIVER, LOUISVILLE (LOWER), KY. (364 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 392.85 feet above the Cairo datum plane.]

1891	Feb. 26–27	58.00	Oct. 16–18	4.10	Previous highest, Feb. 16, 1884, 72 feet; previous lowest, Oct. 17–18, 1872, 1.60 feet.
1892	Apr. 23	47.40	Nov. 7	2.70	
1893	Feb. 22	54.40	Sept. 1–3	3.10	
1894	Feb. 14	35.20	Sept. 7	2.60	

OHIO RIVER, PADUCAH, KY. (45 MILES FROM MOUTH).

[U. S. Weather Bureau gauge; zero, 308.40 feet above the Cairo datum plane.]

1891	Mar. 4	45.3	Nov. 4–6	1.0	Previous highest, Feb. 23, 1884, 54.25 feet; previous lowest, Dec. 29, 1876, Sept. 15, 1887, 0.25 foot.
1892	Apr. 29	42.9	Oct. 30–Nov. 2	0.7	
1893	Feb. 27	44.3	Sept. 4–5	1.	
1894	Feb. 15–16	36.3	Nov. 1–2, 4, 7	−0.2	

OHIO RIVER, CAIRO, ILL. (1 MILE FROM MOUTH).

[U. S. Engineer gauge; zero, 290.84 feet above the Cairo datum plane.]

1891	Mar. 4–6	46.21	Oct. 10–11	2.07	Previous highest, Feb. 27, 1883, 52.17 feet; previous lowest, Dec. 24, 1871, −1 foot.
1892	Apr. 28	48.29	Oct. 29	3.85	
1893	May. 9	49.33	Sept. 5	4.62	
1894	Feb. 16	37.00	Nov. 3	2.81	

OUACHITA RIVER, CAMDEN, ARK. (485 MILES FROM MOUTH OF RED RIVER).

[U. S. Engineer gauge; zero, 91.00 * feet above the Cairo datum plane.]

1891	Feb. 5	35.6	Nov. 4–9	2.90	Previous highest, 1882, 46 feet; previous lowest, Aug. 29–30, 1887, 1.80 feet.
1892	June 6	37.10	Oct. 12–14	3.50	
1893	Jan. 5–6	34.80	Nov. 4	2.70	
1894	Mar. 23	43.25	Oct. 31, Nov. 1	2.80	

* Preliminary value.

OUACHITA RIVER, MONROE, LA. (271 MILES FROM MOUTH OF RED RIVER).

[U. S. Weather Bureau gauge; zero, 51.22 feet above the Cairo datum plane.]

1891	Mar. 16–18	38.5	Nov. 4–9	0.90	Previous highest, 1882, 48.60 feet; previous lowest, Oct. 17–23, 1887, 0.42 foot.
1892	June 27–29	41.1	Oct. 19	1.7	
1893	Jan. 9–11, 13–15	40.2	Nov. 3–5	1.1	
1894	Apr. 10–11	45.0	Nov. 1–2 / Oct. 27–28	1.0	

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

RED RIVER, FULTON, ARK (676 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 244.78 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading	
		Feet.		*Feet.*	
1891	Apr. 27-28	30.3	Dec. 2-3	3.8	Previous highest, July 17, 1876, 35.75 feet; previous lowest, Sept. 7, 1887, 0.60 foot.
1892	May 23-24	34.85	Oct. 14	5.2	
1893	Mar. 13	26.80	Nov. 20	3.35	
1894	Mar. 24	33.00	Nov 27-Dec. 7.	2.85	

RED RIVER, GARLAND, ARK. (618 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 223.44 feet above the Cairo datum plane.]

1891	Apr. 28	27.64	Nov. 20	2.12	Previous highest, 1885, 28.34 feet; previous lowest, Aug. 17-18, 1890, 2.86 feet.
1892	May 24-25	28.40	Oct. 14	2.66	
1893	Mar. 13-14	25.70	Nov. 19-20	1.69	
1894	Mar. 24	28.50	Nov. 30-Dec. 2.	1.10	

RED RIVER, SHREVEPORT, LA. (456 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 161.27 feet above the Cairo datum plane.]

1891	Feb. 12-13	25.20	Nov. 14-16, 20.	—1.50	Previous highest, May 8, 1890, 34.70 feet; previous lowest, Sept. 8-11, 1887, —0.60 foot.
1892	May 28	35.70	Oct. 13-15	—2.00	
1893	Jan. 1-2	29.10	Oct. 1-2, Nov. 20.	—2.60	
1894	Apr. 2	34.40	Dec. 2-4	—5.50	

RED RIVER, ALEXANDRIA, LA. (139 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, 64.46 feet above the Cairo datum plane.]

1891	Feb. 16-17	29.95	Nov. 16, 19-20.	—1.85	Previous highest, May 30-June 5, 1884, 35.25 feet; previous lowest, Sept. 29, 1881, —3.70 feet.
1892	June 12-13	38.25	Oct. 20-23	—0.65	
1893	Jan. 7	32.25	Nov. 20	—1.40	
1894	Apr. 12	35.15	Dec. 2-3	—2.25	

ST. FRANCIS RIVER, BRIDGE ST. LOUIS, IRON MOUNTAIN AND SOUTHERN RAILWAY (194 MILES FROM MOUTH).

[Mississippi River Commission gauge; zero, —— feet above the Cairo datum plane.]

1891					
1892					
1893	May 21-22	41.10	Sept. 23-25	1.00	
1894	Mar. 21	25.00	Nov. 20-22	0.52	

ST. FRANCIS RIVER, WITTSBURG, ARK. (180 MILES FROM MOUTH).

[Mississippi River Commission gauge; zero, —— feet above the Cairo datum plane.]

1891	Mar. 21	36.98	Nov. 3-7	—3.52	Previous highest, Apr. 28, 1886, 42.02 feet; previous lowest, Oct. 30-31, 1887, —2.90 feet; discontinued Oct. 14, 1893.
1892	May 9	39.4	Oct. 27-31, Nov. 10-14.	—3.60	
1893	May 20-23	40.10	Sept. 21, 22-27-Oct. 3.	—2.30	
1894					

Highest and lowest gauge readings for each year, 1891 to 1894, etc.—Continued.

TENNESSEE RIVER, CHATTANOOGA, TENN. (532 MILES FROM CAIRO).

[U. S. Weather Bureau gauge; zero, *651.90 feet above the Cairo datum plane.]

Year.	Highest.		Lowest.		Remarks.
	Day.	Gauge reading.	Day.	Gauge reading.	
		Feet.		*Feet.*	
1891	Mar. 11	38.9	Nov. 4-10	1.2	Previous highest, March 11, 1867, 58.05 feet; previous lowest, Sept. 11-14, 1881, Sept. 19, 1883, 0.00 foot.
1892	Jan. 17	37.9	Oct. 26-Nov. 1.	1.1	
1893	Feb. 20	33.4	Aug. 28-29, 31.	1.6	
1894	Feb. 6	25.5	Oct. 27-29, Nov. 18.	0.7	

* Preliminary value.

TENNESSEE RIVER, FLORENCE, ALA. (345 MILES FROM CAIRO)

[U. S. Engineer gauge; zero, —— feet above the Cairo datum plane.]

1891	Mar. 15	22.20	Oct. 19-Nov. 9.	1.00	Previous highest, ——, 1867, 31.1 feet; previous lowest, Sept. 18, 1878, —0.76 foot.
1892	Apr. 8	24.00	Oct. 28-Nov. 2.	0.80	
1893	Feb. 17	21.40	Aug. 31-Sept. 1	1.10	
1894	Feb. 9	17.70	Oct. 27, 30-Nov. 2.	—0.10	

WABASH RIVER, MOUNT CARMEL, ILL. (252 MILES FROM CAIRO).

[U. S. Weather Bureau gauge; zero, *397.81 feet above the Cairo datum plane.].

1891	Mar. 2	22.0	Nov. 7-9	0.4	Previous highest, Jan. 13-15, 1890, 25.10 feet; previous lowest, Sept. 25-29, Oct. 30-Nov. 24, 1887, 0.6 foot.
1892	Apr. 13	21.5	Oct. 13-22	0.6	
1893	May 8-9	24.5	Sept. 4-29	0.8	
1894	Feb. 15	14.4	Oct. 29-Nov. 25.	0.7	

* Preliminary value.

WHITE RIVER, JACKSONPORT, ARK. (360 MILES FROM MOUTH).

[U. S. Engineer gauge; zero, —— feet above the Cairo datum plane.]

1891	Apr. 26	23.75	Oct. 10-Nov. 4.	0.50	Previous highest, Feb. 15, 1884, 32.80 feet; previous lowest, Dec. 24, 1872, —1.10 feet.
1892	May 20	30.40	Oct. 13-14	0.80	
1893	May 3-5	31.15	Sept. 23-24, Nov. 14-22.	1.00	
1894	May 11	28.90	Nov. 30-Dec. 1	0.70	

WHITE RIVER, CLARENDON, ARK. (134 MILES FROM MOUTH).

[Mississippi River Commission gauge; zero, —— feet above the Cairo datum plane.]

1891	Mar. 19	29.1	Nov. 1-6	5.75	Previous highest, Jan. 6, 1885, 33.58 feet; previous lowest, Nov. 22, 1887, 4.07 feet.
1892	May 27-28	32.65	Oct. 19-20	6.45	
1893	May 11	33.95	Nov. 16-20	6.50	
1894	Feb. 20	30.80	Nov. 5-6	6.20	

YAZOO RIVER, YAZOO CITY, MISS. (65 MILES FROM MOUTH).

[U. S. Weather Bureau gauge; zero, 93.34 feet above the Cairo datum plane.]

1891	Mar. 8	29.98	Nov. 8	—1.70	Previous highest, 1882, 36.50 feet; previous lowest, 1875, —4.30 feet.
1892	Apr. 29-30	27.40	Oct. 31	—1.00	
1893	May 23-24	25.6	Nov. 3-9	—1.0	
1894	Apr. 10-11	24.5	Nov. 7-16	—1.9	

APPENDIX 4 K.

ACTS OF CONGRESS PASSED SINCE OCTOBER 19, 1888, AFFECTING THE MISSISSIPPI RIVER COMMISSION.

[Copies of acts passed previous to that date will be found in the Annual Report of the Mississippi River Commission for fiscal year ending June 30, 1889.]

An act to amend an act entitled an act authorizing the Mississippi and Louisiana Bridge and Railroad Company of Natchez, Mississippi, to construct a bridge over the Mississippi River at or near Natchez, Mississippi. (Approved July 19, 1888. For act referred to see Rept. C. of E. 1888, p. 2875.)

* * * * * * *

That section twelve of the above recited act be amended so as to read, "That if the construction of said bridge is not commenced by the first day of January, eighteen hundred and ninety-two, and completed in three years thereafter, all rights hereby conferred shall cease and determine." (Approved June 10, 1890. Rept. C. of E. 1890, p. 3631.)

* * * * * * *

Improving Mississippi River from the Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, travelling and miscellaneous expenses of the Mississippi River Commission: Continuing improvement, three million two hundred thousand dollars, which sum shall be expended under the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, for the general improvement of the river, the building of levees, for surveys, including the survey from the Head of the Passes to the headwaters of the river, for the work at the harbors at Hickman, Kentucky; at New Madrid, Missouri; at Helena, Arkansas; at Greenville, Vicksburg, and Natchez, Mississippi; at New Orleans, Louisiana; at the head of the Atchafalaya and the mouth of the Red River, and at other localities, in such manner, to such extent and in such proportion as in their opinion shall best promote the interests of commerce and navigation: *Provided*, That the amount expended from such sum for work at the harbors aforesaid shall not exceed six hundred thousand dollars, and the amount expended at the head of the Atchafalaya and the mouth of Red River for the rectification thereof pursuant to the plan heretofore adopted, including keeping open a navigable channel through the mouth of Red or Old River into the Mississippi River shall not exceed two hundred and fifty thousand dollars. (River and harbor bill, approved September 19, 1890. Rept. C. of E. 1890, p. 3656.)

* * * * * * * *

Mississippi River Commission: For salaries of the Commission, five thousand six hundred and twenty-five dollars. (Deficiency bill, approved September 30, 1890. Rept. C. of E., 1890, p. 3699.)

* * * * * * *

That the president of the Mississippi River Commission be, and is hereby, authorized, out of money heretofore appropriated for the improvement of the Mississippi River, to purchase or hire such boats as may be immediately necessary to rescue inhabitants in the overflowed districts of the Mississippi River Valley, and to use said boats for the purpose named. (Joint resolution, approved April 3, 1890. Rept. C. of E., 1890, p 3715.)

* * * * * * *

That the sum of one hundred and fifty thousand dollars is hereby appropriated to be expended by and under the direction of the Secretary of War in the purchase and distribution of subsistence stores to such destitute persons as may require assistance in the district overflowed by the Mississippi River and its tributaries by the recent floods. And the Secretary of War is authorized to use the steamers and other boats and vessels belonging to or now employed by the Government on the Mississippi River and its tributaries in the transportation and distribution of the supplies furnished by the United States or individuals to and among said destitute and suffering people, and he may employ such other means of transportation as he may deem necessary to carry the purpose of this joint resolution into effect. (Joint resolution approved April 25, 1890. Rept. C. of E., 1890, p. 3716.)

* * * * * * *

Mississippi River Commission: For salaries of the Mississippi River Commission from July first, eighteen hundred and ninety, to September eighteenth, eighteen hundred and ninety, inclusive, one thousand nine hundred and fifty dollars. (Deficiency bill, approved March 3, 1891. Rept. C. of E., 1891, p. 505.)

* * * * * * *

That the sum of one million dollars is hereby appropriated, to be paid out of any money in the Treasury not otherwise appropriated, for the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio River, which sum shall be immediately available and shall be expended under the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission: *Provided*, That no portion of this appropriation shall be expended to repair or build levees for the purpose of reclaiming lands or preventing injury to lands or private property by overflows: *Provided, however*, That the Commission is authorized to repair and build levees, if in their judgment it should be done, as a part of their plans to afford ease and safety to the navigation and commerce of the river and to deepen the channel: *Provided further*, That the office, clerical, and traveling expenses and salaries of the Mississippi River Commission may be paid from this appropriation. (Joint resolution, approved March 3, 1891. Rept. C. of E., 1891, p. 513.)

* * * * * * *

Improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission: Continuing improvement, two million dollars, which sum shall be expended, under the direction of the Secretary of War, in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, as approved by the Chief of Engineers, for the general improvement of the river, for the building of levees, and for surveys, including the survey from the Head of the Passes to the head waters of the river, in such manner as in their opinion shall best improve navigation and promote the interests of commerce at all stages of the river: *Provided*, That on and after passage of this act additional contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry on continuously the plans of the Mississippi River Commission as aforesaid, or such materials may be purchased and work may be done otherwise than by contract, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate two million six hundred and sixty-five thousand dollars per annum for three years, commencing July first, eighteen hundred and ninety-three.

For work in accordance with the plans and specifications of the Mississippi River Commission:

At the harbor of Greenville, Mississippi, continuing improvement, one hundred thousand dollars.

At the harbor of Vicksburg, Mississippi, continuing improvement, eighty thousand dollars.

At the harbor of New Orleans, Louisiana, continuing improvement, eighty thousand dollars.

At the harbor of Natchez and Vidalia, Mississippi and Louisiana, eighty thousand dollars.

At the harbor of Memphis, Tennessee, twenty-five thousand dollars.

At the harbor of New Madrid, Missouri, twenty-five thousand dollars.

At the head of the Atchafalaya and the mouth of Red River, Louisiana, for the rectification thereof, continuing improvement, eighty thousand dollars.

* * * * * * *

SEC. 2. That in cases where authority has been granted to the Secretary of War in this act to make contracts for the completion of certain works of river and harbor improvement, he is hereby authorized to reject any bids not in his opinion advantageous to the Government, and to issue new proposals.

SEC. 3. That section seven of the river and harbor act of September nineteenth, eighteen hundred and ninety, be amended and reenacted so as to read as follows:

"SEC. 7. That it shall not be lawful to build any wharf, pier, dolphin, boom, dam, weir, breakwater, bulkhead, jetty, or structure of any kind outside established harbor lines, or in any navigable waters of the United States where no harbor lines are or may be established, without the permission of the Secretary of War, in any port, roadstead, haven, harbor, navigable river, or other waters of the United States, in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters, and it shall not be lawful hereafter to commence the construction of any bridge, bridge draw, bridge piers and abutments, causeway, or other works over or in any port, road, roadstead, haven, harbor, navigable river, or navigable waters of the United States, under any act of the legislative assembly of any State, until the location and plan of such bridge or other works have been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of any port, roadstead, haven, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless approved and authorized by the Secretary of War: *Provided*, That this section shall not apply to any bridge,

bridge draw, bridge piers, and abutments, the construction of which has been tofore duly authorized by law, or be so construed as to authorize the constru of any bridge, drawbridge, bridge piers and abutments, or other works, und act of the legislature of any State, over or in any stream, port, roadstead, h or harbor or other navigable water not wholly within the limits of such State.

* * * * * * *

SEC. 5. That no money appropriated for the improvement of rivers and harb this act, or hereafter, shall be expended for dredging inside of harbor lines established. (River and harbor bill, approved July 13, 1892. Rept. C. of E., pp. 3488-3516.)

* * * * * *

For Mississippi River Commission: Forty-four dollars and eighty cents. (ciency bill, approved July 28, 1892. Rept. C. of E., 1892, p. 3535.)

* * * * * *

That the service and employment of all laborers and mechanics who are n may hereafter be employed by the Government of the United States, by the Di of Columbia, or by any contractor or subcontractor upon any of the public wo the United States or of the said District of Columbia, is hereby limited and restr to eight hours in any one calendar day, and it shall be unlawful for any offi the United States Government or of the District of Columbia, or any such contr or subcontractor whose duty it shall be to employ, direct, or control the servi such laborers or mechanics, to require or permit any such laborer or mechanic to more than eight hours in any calendar day except in case of extraordinary emerg

SEC. 2. That any officer or agent of the Government of the United States or o District of Columbia, or any contractor or subcontractor whose duty it shall employ, direct, or control any laborer or mechanic employed upon any of the p works of the United States or of the District of Columbia, who shall intentio violate any provision of this act, shall be deemed guilty of a misdemeanor, an each and every such offence shall, upon conviction, be punished by a fine n exceed one thousand dollars or by imprisonment for not more than six months, both such fine and imprisonment, in the discretion of the court having jurisdi thereof.

SEC. 3. The provisions of this act shall not be so construed as to in any manner to or affect contractors or subcontractors, or to limit the hours of daily servi laborers or mechanics engaged upon the public works of the United States or o District of Columbia, for which contracts have been entered into prior to the pa of this act. (Approved August 1, 1892. Rept. C. of E., 1892, p. 3541.)

* * * * * *

That the Southern Bridge and Railway Company, a corporation duly incorpo under the laws of the State of Louisiana, be, and the same is hereby, autho and empowered to erect, construct, and maintain a bridge over the Mississippi R the approach to which, on its left bank, shall be within the upper limits of the of New Orleans, if practicable, or within five miles above said city limits, i State of Louisiana, at such location as may be approved by the Secretary of Said bridge shall be constructed for the use and connections of the railroads on e side of the river, and for other purposes.

SEC. 2. That any bridge built under this act and subject to its limitations sh a lawful structure, and shall be recognized and known as a foot route, upon w also no higher charge shall be made for the transportation over the same o mails, the troops, and munitions of war of the United States than the rate per paid for the transportation over the railroads or public highways leading to the bridge, and it shall enjoy the rights and privileges of other post roads in the U States.

SEC. 3. That the said bridge shall be made with three unbroken and continuous between the river banks, as defined by a medium stage of water, and with but piers in the river. The length of the main channel span shall be at least one thou feet long, measured between the piers at the surface of the water at low water the height of the superstructure above high water shall be fixed and determin the Secretary of War; and the bridge shall be at right angles to, and its piers allel with, the current of the river: *Provided*, That the lower chord of the b shall be horizontal and the lowest point of the superstructure shall not be less eighty-five feet above high water: *Provided also*, That said Southern Bridge Railway Company shall have posted in a conspicuous place, on or near the br the clear head room under the channel span on each day, the figures expressing height to be not less than two feet high, and to be readily visible from any point i channel of the river for a stretch of three thousand feet above and one thou feet below the bridge. The bridge shall be located above the city of New Orl No bridge shall be erected or maintained under the authority of this act which

at any time substantially or materially obstruct the navigation of said river, and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such alterations shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the case may be brought in the circuit court of the United States within whose jurisdiction any portion of said obstruction or bridge may be located: *Provided further*, That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers or to exempt this bridge from the operation of the same.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them desiring such use, shall fail to agree upon the sum or sums to be paid and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon reasonable notice to the parties in interest, and upon consideration of such allegations and proofs as may be submitted to him. But the last foregoing provision shall not be held to exclude the ordinary jurisdiction of the courts of the United States in such cases.

SEC. 5. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge and a map of the location, giving for the space of two miles above and two miles below the proposed location the topography of the banks of the river, the shore lines at high and low water, and at least one medium stage, and the sounding, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built or commenced; and should any change be made in the plans of said bridge during the process of construction, such change shall be subject to approval of the Secretary of War, and shall not be made or commenced until the same is approved; and the said company or corporation shall cause to be displayed on said bridge from the hours of sunset to sunrise such lights or other signals as may be prescribed by the Light-House Board: *Provided*, That nothing in this section shall be construed as giving authority to the Secretary of War to diminish the height of bridge or width of spans as specified in section three of this act.

SEC. 6. That it shall be the duty of the Secretary of War, on satisfactory proofs that a necessity exists therefor, to require the company or persons owning said bridge to cause such aids to the passage of said bridge to be constructed, placed, and maintained at their own cost and expense in the form of booms, dikes, piers, or other suitable or proper structures for the guiding of rafts, tows, steamboats, and other water craft safely through the passageway, as shall be specified in his order in their behalf, and on failure of the company or persons aforesaid to make and establish and maintain such additional structures within a reasonable time, the said Secretary may cause the said bridge to be removed at the expense of the owners thereof, or may proceed to cause the same to be built or made at the expense of the owners of the said bridge, and in that case shall refer the matter without delay to the Attorney-General of the United States, whose duty it shall be to institute, in the name of the United States, proceedings in any circuit court of the United States within whose jurisdiction such bridge, or any part thereof, is located for the recovery of the amount so expended by the Government and all costs of such proceedings, and all moneys accruing from such proceedings shall be covered into the Treasury of the United States.

SEC. 7. That if the construction of the bridge hereby authorized shall not be commenced within two years from the time this act takes effect, and be completed within five years after the same date, then this act shall be void, and all rights hereby conferred shall cease and determine.

SEC. 8. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure, or its entire removal, at the expense of the owners, whenever the Secretary of War shall decide that the public interests require it, is also expressly reserved. (Act approved January 26, 1893. Rept. C. of E., 1893, pp. 526–528.)

* * * * * * *

Under Mississippi River Commission: For improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, two million six hundred and sixty-five thousand dollars. (Sundry civil bill approved March 3, 1893. Report C. of E., 1893, p. 588.)

* * * * * * *

For work in accordance with the plans and specifications of the Mississippi River Commission: At the harbor of Greenville, Mississippi, continuing improvement, eighty thousand dollars.

At the harbor of New Madrid, Missouri, continuing improvement, twenty thousand dollars.

At the harbor of New Orleans, Louisiana, continuing improvement, one hundred and ten thousand dollars.

At the harbor of Natchez, Mississippi, and Vidalia, Louisiana, continuing improvement, eighty thousand dollars.

At the harbor of Memphis, Tennessee, continuing improvement, fifty thousand dollars, of which ten thousand dollars may be used in dredging at the mouth of Wolf River, in the discretion of the Secretary of War.

The Mississippi River Commission shall cause to be expended on the harbor of Hickman, Kentucky, the unexpended balance of any appropriation heretofore made for improving the harbor at that point.

At the head of the Atchafalaya and the mouth of the Red River, Louisiana, for the rectification thereof, continuing improvement, seventy thousand dollars, of which two thousand five hundred dollars may be used in improving Bayou des Glaises, in the parish of Avoyelles. And the said Commission is directed to report to Congress in their next regular report their views on the advisability of effecting a separation between the Mississippi and Red rivers at the present junction thereof and maintaining navigation between the same through Bayou Plaquemine or by means of a canal. (River and harbor bill approved August 17, 1894.)

(This act in the item appropriating $83,000 for continuing improvement of St. Francis River, Arkansas, provides that $75,000 of this amount is to be expended by the Mississippi River Commission for the prevention of a formation of a cut through to the St. Francis River by the action of the overflow water from the Mississippi River as recommended in the report of Col. Chas. R. Suter, dated May 29, 1894. (Copy of C. of E. letter, p. 177, Proc. M. R. C. River and harbor bill approved August 17, 1894.)

* * * * * * *

Under Mississippi River Commission: For improving Mississippi River from Head of Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, two million six hundred and sixty-five thousand dollars. (Sundry civil bill approved August 18, 1894.)

* * * * * * *

Under Mississippi River Commission: For improving Mississippi River from Head of Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, two million six hundred and sixty-five thousand dollars. (Sundry civil bill approved March 1895.)

(From printed copy of sundry civil bill, 1896, p. 42.)

This is verified by letter of Colonel Gillespie dated April 15, 1895.

* * * * * * *

Improving Saint Francis River, Arkansas: Continuing improvement, eighty-thousand dollars, seventy-five thousand dollars of which to be expended by the Mississippi River Commission for the prevention of a formation of a cut through the Saint Francis River by the action of the overflow water from the Mississippi River, as recommended in the report of Colonel Charles R. Suter, dated May twenty-ninth, eighteen hundred and ninety-four. (Received by the President August 1894.)

NOTE BY THE DEPARTMENT OF STATE.—The foregoing act having been presented to the President of the United States for his approval, and not having been returned by him to the House of Congress in which it originated within the time prescribed by the Constitution of the United States, has become a law without his approval. (River and harbor bill. C. of E., 1894, p. 3546.)

TABLE NO. 1.

DESCRIPTIONS AND APPROXIMATE ELEVATIONS ABOVE MEMPHIS DATUM OF SECONDARY TRIANGULATION STATIONS FROM PRAIRIE DU CHIEN, WIS., TO TREMPEALEAU, WIS.

Hanging Rock: Copper bolt leaded in solid rock; 1 meter from edge of overhanging ledge on very prominent detached cliff commonly known as "Hanging Rock;" 4¼ miles above North McGregor, Iowa, and 1 mile above Yellow River Station, on Chicago, Milwaukee and St. Paul Railroad. Approximate elevation, 885 feet.

Picatee: Tile and pipe on Wisconsin side, 5 miles above Prairie du Chien, on partly cleared bluff point; 200 meters below Chicago, Burlington and Northern Railroad milepost No. 245–186; 20 meters from crest of bluff, 5 meters north of 12-inch blazed burr oak tree and 3½ meters west of 8-inch blazed burr oak. Approximate elevation, 964 feet.

Lanka: Tile and pipe on Wisconsin side; on property of Joe Lanka, in section 19, Eastman Township, Crawford County; on high cultivated ground, 65 meters east of fence on west side of field at edge of timber, just below head of small ravine. Said ravine is branch of larger ravine whose mouth is just above railroad culvert No. 250, 58 meters southwest of 20-inch blazed oak. Approximate elevation, 1,173 feet.

Painted Rocks: Copper bolt in natural rock on Iowa side; 1½ meters north and 1½ meters east from edges of highest exposed rock at lower corner of bluff, just above ravine, about three-fourths mile north of Waukon Junction, Iowa. Approximate elevation, 925 feet.

Sioux: Tile and pipe 5 miles below Lynxville, Wis.; one-fourth mile below mouth of Gordon's Bay; 1½ miles above mouth of Sioux Creek; three-fourths mile from river on ridge above Chicago, Burlington and Northern Railroad bridge No. 257. Station is on property of Mike Grouert in scattering oak timber, 4 meters north of wood road leading up ravine from bridge No. 257. Approximate elevation, 1,178 feet.

Oil Spring: Tile and pipe on bluff 2½ miles above Harpers Ferry, Iowa, and just below Oil Spring Schoolhouse. On property of Joseph Valley; at north edge of oak timber, which covers lower corner of bluff, 30 meters south of cornfield, 50 meters from crest of bluff, 150 meters southeast of wagon road which runs from main ravine above station up smaller ravine to the south. Chicago, Milwaukee and St. Paul Railroad bridge K 476 and milepost No. 49–112 stand in mouth of ravine above station. Azimuth Oil Spring to 12-inch blazed oak, 55° 24′, distance 26 meters; azimuth Oil Spring to 12-inch blazed oak, 196° 31′, distance 4 meters. Approximate elevation, 1,027 feet.

Lynxville: Tile and pipe on crest of bluff, opposite point 100 meters above depot at Lynxville, Wis.; at west edge of field 230 meters above lower corner. On property of David Heligas, 13 meters south of 18-inch blazed oak. Approximate elevation, 1,056 feet.

Madden: Tile and pipe on Iowa side, 1½ miles below railroad station (Heytmans) on line of fence between property of David Gilliand and Ned Madden, about 200 meters south of house; 20 meters from 6-inch blazed oak. Approximate elevation, 1,063 feet.

Dagnon: Tile and pipe on narrow rocky bluff, about 2½ miles above Lynxville, Wis.; 500 meters above Chicago, Burlington and Northern milepost No. 173–258; 300 meters above lower point of bluff and opposite point; 50 meters below head of small island. Station is on property of David Kane. Approximate elevation, 1,047 feet.

Ferryville: Tile and pipe on prominent bluff point, between two large ravines, 1 mile below Ferryville, Wis., at edge of timber on partially bald bluff; 25 meters in front of highest ground and 9 meters west of 8-inch blazed oak. Approximate elevation, 1,039 feet.

Heytmans: Tile and pipe one-half mile above Heytmans, Iowa, railroad station; in open field, on highest ground on ridge one-fourth mile above its lower point and 70 meters west of timber at top of bluff. Approximate elevation, 1,070 feet.

Rush Creek: Tile and pipe about 2 miles above Ferryville, Wis., one-half mile above milepost No. 167–264, on first ridge above railroad bridge No. 285. Station is about 200 meters back of prominent bare point of ridge and 20 meters west of highest ground. Azimuth Rush Creek to 10-inch oak, 106° 42′, distance 5 meters; azimuth Rush Creek to 10-inch oak, 233° 43′, distance 11 meters. Approximate elevation, 1,064 feet.

Columbus: Tile and pipe 100 meters south of Mr. Whalen's house, in section 4 Lafayette Township, Allamakee County, Iowa; about 2 miles below Lansing and three-fourths mile back on bluff; 2 meters west of fence on east side of Columbus Ridge road; 46 meters south of fence corner on east side and 110 meters south of

barn on west side of road. This road leads up ravine from road along foot of bluff at Chicago, Milwaukee and St. Paul Railroad bridge K 520, 1 mile below Lansing, Iowa. Approximate elevation, 1,100 feet.

△ Wyburn: Copper bolt in top of large exposed rock, on bluffs about 2 miles below De Soto, Wis. On property of Lafayette Wyburn, in township 11, section 26, Crawford County, Wis., at junction of north and south ridge road, with one leading west to residence. Rock stands in a small white oak grove. Approximate elevation, 1,197 feet.

△ Cowles: Tile and pipe on bluff, about 2 miles above Lansing, Iowa, on land of John Bakewell; at southeast corner of cultivated field on bluff point above ravine at Chicago, Milwaukee and St. Paul Railroad bridge K 536 and milepost 33-128. Nine-inch blazed oak is 22 meters south and 8-inch oak marked with cross is 17 meters south. Approximate elevation, 1,109 feet.

△ Battle Ground: Tile and pipe on top and near crest of partly wooded bluff point, about 3 miles above De Soto, Wis.; on first bluff above Battle Hollow, opposite head of bog along railroad tracks. Approximate elevation, 1,147 feet.

△ Upper Base: Tile and pipe at northwest end of De Soto base line, about 2 miles above De Soto, Wis.; on island No. 140, 10 meters from right bank of main channel of river and 545 meters above a wire fence extending west from top of bank; about 200 meters below diamond board on right bank. Azimuth to 20-inch blazed oak, 323° 55′, distance 14 meters; azimuth to 30-inch blazed elm, 86° 48′, distance 10 meters. Elevation cap on pipe, 632.56 feet.

△ Lower Base: Tile and pipe on island, 140,300 meters above a point opposite mouth of large bay; 1 mile above De Soto, Wis.; in grass and open timber 30 meters from river bank. Azimuth to blazed elm, 153° 25′, distance 22 meters; azimuth to blazed elm, 296° 1′, distance 22 meters. Elevation top of pipe, 631.29 feet.

△ Kains: Tile and pipe at crest of wooded bluff point, about 700 meters above railroad station, Kains, Iowa. The first house near railroad above railroad station stands in mouth of ravine below secondary. Azimuth to 30-inch blazed oak, 104° 45′, distance 13 meters; azimuth to 15-inch blazed oak, 268°, distance 17 meters. Approximate elevation, 1,137 feet.

△ New Albin: Iron pipe centered over copper bolt in rock at crest of first bluff point above and back of schoolhouse at Jefferson, Houston County, Minn., and 1¼ miles above New Albin, Iowa; 30 meters in front of highest ground on bluff and three-fourths mile above Minnesota-Iowa State line. Azimuth to 10-inch blazed oak, 151° 32′, distance 8 meters. Approximate elevation, 1,108 feet.

△ Reno: Tile and pipe on property of Albert Richard, at crest of bluff, about 1 mile below Reno, Minn.; at east edge of cultivated field, about 50 meters above head of drain leading to railroad bridge No. 614. A 10-inch blazed oak stands 19 meters south; a 12-inch blazed oak stands 23 meters north. Approximate elevation, 1,089 feet.

△ Elgar: Tile and pipe on high ridge, in cultivated field on property of J. F. Elgar, section 9, township 12, range 7, about 2 miles above Victory, Wis.; 30 meters east of northeast corner of cornfield, and is equally distant from two ravines. Station is near wagon road leading up ravine from Elgar's residence, which is situated at point where bluff road turns back from railroad along the upper side of Bad Axe Ravine. Approximate elevation, 1,118 feet.

△ Genoa: Tile and pipe on property of John Franzini, on upper end of first ridge above Genoa, Wis.; just below ravine coming out at "One mile to station" signboard on railroad; 2 meters west of fence at edge of field, and 45 meters south of fence corner at edge of timber on south bank of ravine. A 5-inch blazed oak stands 7 meters southwest. Approximate elevation, 1,107 feet.

△ Brown: Tile and pipe on narrow ridge, property of George Brown, 1¼ miles above Reno, Minn.; three-fourths mile above point where Raft Channel leaves the bluffs; 165 meters above a depression in top of bluff; 75 meters above exposed rock, formerly a quarry; one-fourth mile above a prominent rock at end of ridge above and back of Mr. Brown's house. A 15-inch blazed oak stands 4 meters west. Approximate elevation, 1,087 feet.

△ Stoddard: Tile and pipe on hillside, about two-thirds of the distance from bottom to top of bluff, in small open spot above small draw; opposite lower end of cornfield, 100 meters above old stone house back of railroad, and about 1 mile above Stoddard, Wis. Azimuth to 5-inch oak, marked with cross, 195° 34′, distance 15 meters; azimuth to 8-inch oak, blazed, 165° 15′. distance 13 meters; azimuth to 8-inch oak, blazed, 134° 10′, distance 10 meters. Approximate elevation, 984 feet.

△ Brownsville: Tile and pipe on land of Jacob Harer, 10 meters from crest of bluff, on narrow ridge, one-fourth mile above mouth of ravine at Brownsville, Minn. Station is 2 meters east of a small oak and hickory, 1 meter apart. Azimuth to 6-inch blazed oak, 77° 14′, distance 5 meters. Approximate elevation, 1,119 feet.

△ Calvert: Tile and pipe 300 meters northwest of Calvert Railroad station on Wisconsin side; on small mound at edge of sand terrace and 2 meters from edge of

sand ridge, where it slopes to edge of timber in bottoms 30 meters west. Approximate elevation, 666 feet.

△ McDonald: Tile and pipe on upper side of lane leading to Mr. McDonald's house, about 6 miles below La Crescent, Minn., and 1¼ miles below Root River; at northeast corner of barnyard and about 80 meters northeast from stone dwelling house. Station is on property of Michael McDonald, sec. 2, township 103, range 4. Approximate elevation, 1,221 feet.

△ Root River: Copper bolt in rock surmounted by iron pipe on bluff point just below first ravine above Root River and about 2 miles above La Crescent, Minn., midway between crest of bluff and point of ridge at top of rock ledge. There is another similar bluff one-fourth mile below where bluffs turn back on upper side of Root River Valley. Station is nearly on line with Grandfathers Bluff and head of La Plume Island. Approximate elevation, 1,081 feet.

△ Grandfather: Tile and pipe on Grandfathers Bluff, back of La Crosse, Wis.; on second small rocky point, 12 meters above quarry, on lower face of bluff, just north of prolongation of Main street, La Crosse. Approximate elevation, 1,183 feet.

△ Onalaska: Tile and pipe on property of Peter Bruner, on highest ground on high prominent bluff, 1¼ miles north of Onalaska, Wis. Lower side and face of bluff have been quarried. Approximate elevation, 1,236 feet.

△ Dresbach: Tile and pipe on south side of ridge road, about 1 mile below Dresbach, Minn.; 80 meters west from bend in road at crest of bluff on lower side of ravine, and nearly due west from corner of bluff on upper side of same ravine, which comes out at foot of Dresbach Island. Station is 2 meters north from road fence and 5 meters east of fence corner at northeast corner of yard in front of residence of Michael Ready. Approximate elevation, 1,275 feet.

△ Dakota: Tile and pipe on property of Henry Winter, 1¼ miles above Dakota, Minn.; 5 meters back of crest of bluff, on small projecting point, just below where bluff turns back up large ravine; 100 meters above prolongation of dike, extending from right bank to Island No. 90. Azimuth to 8-inch white oak, 217° 25′, distance 4 meters; azimuth to 10-inch black oak, 50° 14′, distance 11 meters. Approximate elevation, 1,259 feet.

△ Holmen: Tile and pipe at edge of timber on crest of bluff, at second rocky point above Holmen, Wis.; three-fourths mile above the town. Azimuth to 8-inch blazed oak, 192° 53′, distance 4 meters; azimuth to 8-inch oak (marked with cross), 296° 20′, distance 4 meters. Approximate elevation, 929 feet.

△ Beardsley: Tile and pipe 4 miles below Trempealeau, Wis., on land of Elam Beardsley; on crest of sand ridge, 200 meters east of the McGilvery Ferry road; 25 meters east from fence and 23 meters south from another fence and 300 meters west of edge of timber in Black River bottoms. Approximate elevation, 756 feet.

△ Trempealeau: Tile and pipe at east end of top of Chicken Breast Bluff; one-half mile back, and one-half mile above Trempealeau, Wis. This bluff is the lower in position of two detached bluffs standing farthest from river. Approximate elevation, 1,153 feet.

△ Richmond: Copper bolt leaded in bare rock, 5 meters back from crest of bluff, opposite 1-mile signboard above Richmond Station, Minn., on property of George Fox; opposite center of Island No. 86, on first bluff below draw spanned by Trestle No. 18 L, on Chicago, Milwaukee and St. Paul Railroad. Approximate elevation, 1,139 feet.

△ West Base: Tile and pipe on west end of Trempealeau base line, 1¼ miles below Trempealeau, Wis., on left bank opposite foot of Island No. 84; 200 meters above first dike, below Trempeleau, 3 meters from river bank. Elevation, cap on pipe 654.97 feet.

△ East Base: Tile and pipe on east end of Trempealeau base line, in edge of heavy timber; 15 meters west of Healys Lake, on east side of meadow land belonging to Mr. Marsh. Elevation, cap on pipe 650.97 feet.

TABLE NO. 2.—*Geographical positions north of Keokuk, Iowa.*

[Referred to the Cairo Astronomical Post.]

Name of station.	Latitude.	Seconds.	Longitude.	Seconds.	Azimuth.	Back azimuth.	To station.	Distance
	° ′ ″	*Meters.*	° ′ ″	*Meters.*	° ′ ″	° ′ ″		*Meters.*
△ Hanging Rock	43 06 20.45	631.0	91 10 44.73	1,011.7	310 40 53.1	130 42 39.8	△ Dousman	4,660.0
					1 09 14.3	181 09 11.1	△ North McGregor	5,201.5
					231 39 14.9	51 40 48.5	△ Picatee	3,950.0
					179 13 37.5	359 13 34.9	△ Painted Rocks	6,375.7
△ Picatee	43 07 39.84	1,229.4	91 08 27.68	625.6	355 29 03.7	175 29 16.8	△ Dousman	5,505.5
					140 58 26.0	320 56 49.5	△ Painted Rocks	5,053.6
					201 15 29.2	21 16 01.5	△ Lanka	2,938.0
△ Painted Rocks	43 09 47.03	1,451.5	91 10 48.54	1,096.5	285 35 54.3	105 38 02.9	△ Lanka	4,410.4
					248 05 52.7	68 06 36.0	△ Sioux	5,808.4
					206 59 39.2	27 01 28.6	△ Oil Spring	7,948.9
					348 37 47.7	.....	△ Dousman House	.....
△ Lanka	43 09 08.56	264.2	91 07 40.54	915.9	198 50 04.3	18 50 38.9	△ Sioux	3,541.5
					133 24 33.2	313 21 53.0	△ Church Spire	7,277.4
△ Sioux	43 10 57.18	1,764.4	91 06 49.91	1,127.2	160 07 47.4	340 06 53.4	△ Oil Spring	5,229.0
					211 51 40.1	31 54 06.7	△ Lynxville	9,152.1
△ Oil Spring	43 13 36.52	1,127.1	91 08 08.66	195.5	246 36 56.8	66 40 17.4	△ Lynxville	7,198.8
					208 39 06.2	28 40 29.5	△ Madden	5,715.3
△ Lynxville	43 15 09.00	277.9	91 03 15.75	355.2	119 13 17.4	299 11 19.9	△ Madden	4,428.7
					183 39 44.8	3 39 54.8	△ Dagnon	5,186.0
					61 30 23.0	241 24 41.3	△ Church Spire	12,817.8
△ Church Spire	43 11 50.55	1,560.0	91 11 34.69	783.2	.....	.....	.....	.....
△ Madden	43 16 19.03	587.2	91 06 07.14	161.0	234 17 07.0	54 19 14.6	△ Dagnon	5,166.2
					168 51 56.6	348 51 30.3	△ Heytmans	4,479.5
					41 46 02.6	.....	△ Church Spire	11,103.2
△ Dagnon	43 17 56.71	1,750.1	91 03 01.05	23.6	105 17 06.2	285 14 32.2	△ Heytmans	5,244.3
					155 59 13.2	335 58 17.4	△ Ferryville	4,498.3
					45 46 02.0	.....	△ Church Spire	.....
△ Heytmans	43 18 41.45	1,279.1	91 06 45.52	1,025.9	229 46 25.6	49 48 03.9	△ Ferryville	4,225.6
					165 44 52.0	345 44 03.9	△ Rush Creek	6,401.2
					111 22 28.0	291 19 12.2	△ Columbus	6,903.6
△ Ferryville	43 20 09.85	304.0	91 04 22.31	502.6	125 55 11.3	305 52 45.0	△ Rush Creek	5,927.7
△ Rush Creek	43 22 02.48	76.6	91 07 55.51	1,250.0	52 45 10.4	232 42 42.5	△ Columbus	6,095.2
					139 26 20.1	319 24 31.7	△ Wyburn	5,461.1
					57 23 26.4	237 19 16.8	△ Church Spire	9,726.4
					85 25 47.6	265 22 16.7	△ Cupola (round)	6,939.2
					86 54 18.4	266 50 46.4	△ Cupola (square)	6,962.1
					85 25 06.1	.....	Lansing Spire	.....
△ Columbus	43 20 02.88	89.0	91 11 30.89	696.0	189 22 57.7	9 23 37.2	△ Wyburn	7,945.3
					156 53 55.3	.....	△ New Albin Spire	19,400.3
					264 45 25.7	.....	White Blunt Spire	.....
					293 44 26.9	.....	White Sharp Spire	.....
					39 33 11.2	.....	Iowa Spire	.....

									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
									26	16	28.9	206	14	07.6	△ Church Spire	10,475.2
									35	34	07.7	215	32	25.1	△ Cupola (round)	5,782.4
△ Church Spire	43	19	12.48	385.2	91	13	59.12	1,332.2								
△ Cupola (round)	43	21	44.45	1,371.8	91	13	02.70	60.8								
△ Cupola (square)	43	21	50.19	1,548.9	91	13	04.26	95.9								
△ Water Tank	43	25	06.70	209.5	91	11	44.75	1,006.8								
(△) Cowles	43	23	48.86	1,507.8	91	16	00.66	14.9	325	52	15.8	145	54	39.8	(△) Columbus	8,422.8
									203	20	52.1	23	22	26.8	(△) Battle Ground	7,814.1
									160	17	32.8	340	16	32.3	(△) Kains	5,867.2
									241	21	57.8	61	24	12.4	△ Water Tank	5,021.6
									165	03	53.1	345	02	24.4	△ New Albin Spire	11,247.1
									235	31	02.1				De Soto Spire	
(△) Battle Ground	43	27	41.31	1,274.7	91	12	42.91	964.5	72	00	36.4	251	58	01.2	(△) Kains	5,837.0
									2	03	23.5	182	03	19.5	(△) Lower Base	3,663.5
									32	59	57.8	212	59	15.5	(△) Upper Base	2,541.9
									134	42	46.6	314	39	49.8	(△) New Albin	8,119.8
									176	23	50.8	356	23	34.7	(△) Elgar	8,340.8
									2	32	26.0	182	32	11.3	△ Cupola (square)	10,846.5
									121	39	27.5	301	36	23.9	△ New Albin Spire	7,041.6
									127	09	55.7	307	06	59.0	△ State Line	7,241.5
(△) Kains	43	26	47.83	1,476.2	91	16	28.65	644.2	292	06	23.5	112	08	54.7	(△) Lower Base	5,338.6
									174	34	11.8	354	33	50.4	(△) New Albin	7,393.8
									296	00	04.6	116	03	19.8	△ Water Tank	7,166.2
									173	22	42.9	353	22	21.5	(△) State Line	6,063.0
(△) Lower Base	43	25	42.67	1,316.9	91	12	48.75	1,096.5	140	40	15.6	320	39	37.3	(△) Upper Base	1,977.0
(△) Upper Base	43	26	32.22	994.4	91	13	44.47	999.9								
(△) New Albin	43	30	46.34	1,430.0	91	16	59.80	1,343.1	243	29	12.4	63	31	53.2	(△) Elgar	5,860.3
									182	03	09.1	2	03	17.9	(△) Reno	8,034.8
									359	58	09.0				△ State Line	1,338.0
△ New Albin Spire	43	29	40.97	1,264.4	91	17	09.67	217.2								
△ State Line	43	30	02.98	92.0	91	16	59.77	1,342.8								
(△) Elgar	43	32	11.04	340.6	91	13	08.25	140.2	137	34	13.3	317	31	41.1	(△) Reno	7,339.7
									176	24	05.3	356	23	53.8	(△) Genoa	5,949.1
(△) Reno	43	35	06.52	201.2	91	16	46.97	1,053.8	263	28	47.5	83	31	08.2	(△) Genoa	4,608.0
									185	37	57.9	5	38	11.8	(△) Brown	4,600.3
									286	34	42.1	106	36	56.5	△ Genoa Spire	4,565.7
(△) Genoa	43	35	23.42	722.8	91	13	22.89	513.5	134	32	08.5	314	30	01.6	(△) Brown	5,785.4
									182	03	07.2	2	03	18.0	(△) Stoddard	9,810.2
△ Genoa Spire	43	34	24.26	748.7	91	13	31.96	717.2								
(△) Brown	43	37	34.86	1,075.8	91	16	26.83	601.4	217	52	33.4	37	54	51.2	(△) Stoddard	7,283.4
									179	58	27.7	359	58	27.6	(△) Brownsville	8,067.4
									326	17	15.8	146	19	16.4	△ Genoa Spire	7,070.0
									177	27	52.0	357	27	41.6	△ School House	7,600.3
									226	35	03.4	46	37	14.5	△ Water Tank	5,857.5
									176	53	36.7				Church Tower	
(△) Stoddard	43	40	41.09	1,268.1	91	13	07.20	161.3	117	25	27.0	297	23	09.0	(△) Brownsville	5,040.1
									180	03	45.9	6	04	13.7	(△) Calvert	8,526.6
									170	44	56.7				△ St. Joseph Spire	

TABLE NO. 2.—*Geographical positions north of Keokuk, Iowa*—Continued.

Name of station.	Latitude.			Seconds.	Longitude.			Seconds.	Azimuth.			Back azimuth.			To station.	Distance.
	°	′	″	*Meters.*	°	′	″	*Meters.*	°	′	″	°	′	″		*Meters.*
△ Water Tank	43	39	45.25	1,396.5	91	13	16.93	379.3								
△ School House	43	41	40.88	1,261.6	91	16	41.84	936.9								
◬ Brownsville	43	41	56.26	1,736.3	91	16	26.99	604.3	221	04	33.4	41	07	19.3	◬ Calvert	8,173.0
									168	23	15.3	348	22	34.0	◬ McDonald	6,629.7
									344	16	25.9	164	18	26.8	△ Genoa Spire	14,490.9
									313	30	15.6	133	32	26.7	△ Water Tank	5,871.0
◬ Calvert	43	45	15.82	488.2	91	12	26.94	602.9	92	53	17.3	272	49	50.0	◬ McDonald	6,712.9
									176	53	33.0	356	53	22.3	◬ Grandfather	6,399.3
									152	25	06.6	332	23	24.0	△ St. Joseph Spire	7,156.7
◬ McDonald	43	45	26.67	823.1	91	17	26.64	596.1	226	21	15.7	46	24	32.4	◬ Grandfather	8,777.2
									166	18	42.6	346	18	09.7	◬ Root River	4,487.1
									209	23	37.4	29	25	22.2	△ St. Joseph Spire	6,896.3
									223	07	36.8	43	09	32.2	△ Brewery Cupola	5,456.4
◬ Grandfather	43	48	42.86	1,322.7	91	12	42.46	948.9	77	09	01.9	257	05	12.3	◬ Root River	7,605.3
									125	03	35.6	304	58	20.9	◬ Dresbach	12,428.4
									178	54	19.3	358	54	13.2	◬ Onalaska	10,268.1
									135	41	32.1	315	40	08.5	△ North La Crosse Spire	3,861.4
									89	05	50.3				△ St. Joseph Spire	2,967.0
									51	40	48.4				△ Brewery Cupola	3,343.6
◬ Root River	43	47	47.92	1,479.1	91	18	14.13	315.9	162	35	19.9	342	33	54.1	◬ Dresbach	9,251.4
									211	03	20.0	31	07	03.5	◬ Onalaska	
									274	29	34.5	94	32	02.8	△ Brewery Cupola	4,806.7
									226	34	37.1	46	37	03.1	△ North La Crosse Spire	6,488.4
									249	38	43.8				△ St. Joseph Spire	
△ St. Joseph Spire	43	48	41.32	1,275.2	91	14	55.20	1,233.6								
△ Brewery Cupola	43	47	35.67	1,100.8	91	14	39.80	889.7								
△ Astronomical Post	43	48	49.52	1,528.2	91	15	03.98	88.9								
△ North La Crosse Spire	43	50	12.38	382.1	91	14	43.20	965.2								
◬ Dresbach	43	52	33.93	1,047.1	91	20	18.12	404.5	252	30	38.1	72	35	47.9	◬ Onalaska	10,455.7
									152	47	17.8	332	45	22.8	◬ Dakota	8,087.6
									261	11	14.6	81	15	39.4	△ Onalaska Spire	8,627.7
◬ Onalaska	43	54	15.49	478.2	91	12	51.25	1,143.7	151	36	04.5	331	33	48.8	◬ Holmen	9,303.3
									38	33	19.7	218	32	34.7	△ Onalaska Spire	2,325.1
△ Onalaska Spire	43	53	16.58	511.7	91	13	56.17	1,253.9								
◬ Holmen	43	58	40.60	1,253.1	91	16	09.76	217.6	26	06	26.5	206	03	34.2	◬ Dresbach	12,600.3
									65	57	59.2	245	53	11.7	◬ Dakota	10,113.9
									117	22	29.3	297	18	53.6	◬ Beardsley	7,792.0
◬ Dakota	43	56	26.94	831.4	91	23	03.94	88.0	196	40	04.2	16	41	16.1	◬ Beardsley	8,043.1
									147	44	31.7	327	41	46.0	◬ Trempealeau	9,956.3
									147	36	24.2				△ Trempealeau Spire	
◬ Beardsley	44	00	36.57	1,128.8	91	21	20.38	453.9	95	22	30.8	275	18	33.0	◬ Trempealeau	7,654.3
									52	13	11.9	232	10	12.1	◬ Richmond	7,303.9
									338	41	19.8				△ St. Joseph Spire	

Ⓐ Trempealeau	44	00	59.67	1,841.5	91	27	02.51	56.0	340	20	29.2	160	21	27.0	Ⓐ Richmond	5,510.7
Ⓐ Richmond	43	58	11.51	355.4	91	25	39.35		308	07	24.2	128	09	21.8	Ⓐ East Base	4,798.9
								877.2	328	29	02.4				△ Trempealeau Spire	1,463.6
									220	48	08.4	40	49	08.2	Ⓐ East Base	2,941.2
Ⓐ East Base	43	59	23.64	729.6	91	24	13.10		188	12	04.0	8	12	14.4	Ⓐ West Base	2,324.8
								292.0	164	34	34.2	344	34	00.3	△ Trempealeau Spire	4,089.2
									92	41	10.6	272	40	21.0	Ⓐ West Base	1,592.1
Ⓐ West Base	43	59	26.05	804.1	91	25	34.47	545.3	119	42	07.1	299	40	33.3	△ Trempealeau Spire	3,464.1
△ Trempealeau Spire	44	00	19.23	593.5	91	26	28.16	627.4								

TABLE No. 3.—*Geographical positions north of Keokuk, Iowa.*

[Referred to the Cairo Astronomical Post.]

Name of station.	Latitude.	Seconds.	Longitude.	Seconds.	Azimuth.	Back azimuth.	To station.	Distance.
	° ′ ″	*Meters.*	° ′ ″	*Meters.*	° ′ ″	° ′ ″		*Meters.*
⊡ 1[3]	43 05 15.11	466.3	91 08 52.09	1,178.3	39 48 50	219 47 30	△ N. McGregor	4,144.7
					128 22 14	308 20 57	△ Hanging Rock	3,248.9
					316 02 43		△ Dousman	1,420.0
⊡ 1[2]	43 05 30.02	926.4	91 10 16.60	375.4	112 33 27	292 33 08	⊡ 1[2]	690.6
					157 46 30	337 46 10	△ Hanging Rock	1,681.1
					297 04 59	117 06 26	△ Dousman	3,254.6
⊡ 1[1]	43 05 38.60	1,191.1	91 10 44.79	1,012.9	296 17 10	116 18 57	△ Dousman	3,942.8
					1 31 03	181 31 00	△ N. McGregor	5,910.2
					326 10 30		Church Spire	
⊡ 1[5]	43 08 10.73	331.1	91 08 36.87	833.4	40 21 22	220 19 55	△ Hanging Rock	4,465.1
					134 58 50	314 57 20	△ Painted Rocks	4,205.3
⊡ 1[4]	43 07 58.57	1,807.4	91 10 21.81	492.9	282 37 21	102 38 39	△ Picatee	3,643.7
					90 50 35	270 50 13	⊡ 1[5]	737.4
					169 46 25		△ Painted Rocks	3,401.1
⊡ 1[6]	43 07 58.93	1,818.6	91 10 54.43	1,230.2	182 17 06	2 17 10	△ Painted Rocks	3,338.9
					280 03 12		△ Picatee	3,368.9
					355 52 15		△ Hanging Rock	3,046.8
⊡ 2[0]	43 09 41.87	1,292.1	91 08 16.66	376.3	28 18 49	208 17 08	△ Hanging Rock	7,059.4
					92 40 34	272 38 50	△ Painted Rocks	3,434.9
					121 33 41	301 33 29	⊡ 2[0]	486.9
⊡ 2[0]	43 09 50.12	1,546.7	91 08 35.02	791.1	88 12 13	268 10 41	△ Painted Rocks	3,017.8
⊡ 2[0]	43 10 14.10	435.1	91 10 37.16	839.4	1 21 32		△ Hanging Rock	
⊡ 2[1]	43 12 12.92	398.7	91 06 25.01	564.6	52 55 11	232 52 10	△ Painted Rocks	7,462.3
					135 58 31	315 58 19	⊡ 2[1]	529.3
⊡ 2[1]	43 12 25.25	779.2	91 06 41.31	932.7				
⊡ 2[1]	43 12 59.69	1,842.0	91 07 59.11	1,334.2	208 19 00		Gable of House	
⊡ 2[2]	43 14 05.30	163.6	91 04 06.38	144.0	48 45 46	228 41 10	△ Painted Rocks	12,081.4
					127 28 46	307 28 35	⊡ 2[2]	445.6
					210 00 51		△ Lynxville	2,274.0
⊡ 2[2]	43 14 14.08	434.5	91 04 22.06	497.8				
⊡ 2[3]	43 15 37.99	1,172.4	91 05 54.26	1,223.7	222 21 30	42 23 29	△ Dagnon	5,794.8
					284 01 49	104 03 38	△ Lynxville	3,685.7
⊡ 2[3]	43 17 19.53	602.7	91 02 58.32	1,314.9	5 34 25	185 34 13	△ Lynxville	4,047.2
					116 17 38	296 15 03	△ Heytmans	5,711.2
					176 55 51		△ Dagnon	1,149.1
					8 03 49		Water Tank	
⊡ 2[3]	43 17 36.48	1,125.8	91 05 04.94	111.5	71 59 24	251 59 04	⊡ 2[2]	703.8
⊡ 2[3]	43 17 29.43	908.2	91 05 34.63	780.8	256 19 11	76 20 57	△ Dagnon	3,563.0
					324 07 48	144 09 24	△ Lynxville	5,347.0
⊡ 2[0]	43 20 55.83	1,722.9	91 05 54.70	1,282.0	15 26 27	196 25 52	△ Heytmans	4,302.2
					77 51 23	257 47 32	△ Columbus	7,747.1

⊡ 29⁶	43	19	46.35	1,430.4	91	07	48.73	1,097.8	12	44	59	192	44	55	⊡ 2¹⁰ 493.3
⊡ 29⁶	43	19	30.76	949.3	91	07	53.56	1,206.8	179	27	38	359	27	37	△ Rush Creek 4,682.3
									255	45	25	75	47	50	△ Ferryville 4,909.8
									293	44	10				△ Dagnon 7,202.7
									121	36	38				△ Cupola (square) 8,215.8
⊡ 29⁶ = ⊡ 29⁶	43	22	19.63	605.8	91	09	12.90	290.5							
⊡ 29⁵	43	20	50.69	1,564.3	91	10	41.87	943.0	41	21	59	221	21	49	⊡ 2¹¹ 467.3
⊡ 29⁵	43	20	38.84	1,198.6	91	10	56.16	1,264.8	237	35	17	57	37	21	△ Rush Creek 4,818.0
									127	22	00				△ Cupola (square)
									120	38	00				Catholic Church Spire
⊡ 29⁴	43	22	12.53	386.7	91	12	43.37	976.5	92	41	04	272	40	39	⊡ 2¹² 814.8
									34	16	15				△ Cupola (square)
⊡ 29³	43	22	13.76	424.6	91	13	19.52	439.6	224	32	09	44	34	03	△ Wyburn 5,332.1
									272	42	06	92	45	48	△ Rush Creek 7,303.4
⊡ 29² = P. B. M. 212	43	25	06.72	207.4	91	11	44.88	1,009.7	61	24	30	241	22	15	△ Cowles 5,017.8
									116	04	57	296	01	42	△ Kains 7,104.3
									67	30	28	247	30	08	⊡ 2¹³ 700.4
⊡ 29⁷	43	24	58.04	1,791.2	91	12	13.65	307.1	247	25	30				△ Water Tank
⊡ 29⁷	43	24	14.71	454.0	91	15	11.96	269.2	342	19	16	162	19	24	△ Cowles 837.5
⊡ 29⁸ = P. B. M. 209 and 210	43	27	17.21	531.1	91	12	44.68	1,004.6	183	03	44	3	03	45	△ Battleground 744.8
⊡ 29⁸	43	27	21.55	665.1	91	13	50.07	1,125.8	106	10	26	286	10	13	⊡ 2¹⁴ 460.7
									248	00	40	68	01	28	△ Battleground 1,628.3
⊡ 29⁹	43	27	25.71	793.5	91	14	09.75	219.2	105	58	00	285	57	39	⊡ 2¹⁵ 694.4
									256	08	47				△ Battleground 2,010.8
⊡ 29⁸	43	27	31.90	984.5	91	14	39.44	886.6							
⊡ 29⁹ = P. B. M. 206 and 207	43	29	47.41	1,463.1	91	13	00.75	16.9	40	09	24	220	07	01	△ Kains 7,249.0
									108	43	53	288	41	09	△ New Albin 5,669.8
									178	24	10	358	24	06	△ Elgar 4,434.3
									128	17	01	308	16	53	⊡ 2¹⁶ 354.8
⊡ 29⁹	43	29	54.53	1,682.9	91	13	13.14	295.1	105	05	06	285	04	46	⊡ 2¹⁷ 677.0
⊡ 29⁹	43	30	00.24	07.4	91	13	42.24	949.0							
⊡ 2¹⁰	43	32	26.88	829.6	91	13	40.90	909.2	84	54	01	264	53	36	⊡ 2¹⁹ 807.7
									55	17	12	235	14	55	△ New Albin 5,446.3
⊡ 2¹⁰	43	32	24.55	757.7	91	14	16.32	366.4	86	49	51	266	49	32	⊡ 2¹⁰ 640.6
									145	56	21	325	54	38	△ Reno 6,034.6
									50	28	14				△ New Albin 4,760.8
⊡ 2¹⁰	43	32	23.40	722.2	91	14	44.81	1,006.2	84	02	27	264	02	04	⊡ 2¹⁸ 760.6
⊡ 2¹⁰	43	32	20.84	643.2	91	15	18.50	415.4							
⊡ 2¹¹	43	34	23.23	716.9	91	13	32.92	738.7	107	04	41	287	02	28	△ Reno 4,554.4
									146	36	33	326	34	34	△ Brown 7,084.7
									113	51	13	293	50	55	⊡ 2¹¹ 650.5
									214	26	06				△ Genoa Spire
⊡ 2¹¹	43	34	31.75	979.9	91	13	59.45	1,333.8	105	56	54	285	54	58	△ Reno 3,908.8
									106	55	30	286	55	08	⊡ 2¹¹ 741.7
									207	13	07				△ Genoa 1,793.2
									290	32	36				△ Genoa Spire
⊡ 2¹¹	43	34	38.75	1,195.9	91	14	31.07	697.1	227	58	01	47	58	48	△ Genoa 2,059.4
⊡ 2¹²	43	37	16.56	511.1	91	15	13.51	302.9	90	29	37	270	29	07	⊡ 2¹² 968.8
⊡ 2¹²	43	37	16.83	519.4	91	15	56.72	1,271.8	90	23	47	270	23	34	⊡ 2¹² 421.8
									129	30	47	309	30	26	△ Brown 875.5
⊡ 2¹³	43	37	16.92	522.2	91	16	15.53	348.2	213	47	51	33	50	01	△ Stoddard 7,584.0
									312	07	05	132	09	04	△ Genoa 5,221.3

TABLE NO. 3.—*Geographical positions north of Keokuk, Iowa*—Continued.

Name of station.	Latitude.	Seconds.	Longitude.	Seconds.	Azimuth.	Back azimuth.	To station.	Distance.
	° ′ ″	*Meters.*	° ′ ″	*Meters.*	° ′ ″	° ′ ″		*Meters.*
⊡ 2½3	43 40 36.27	1119.4	91 15 46.57	1,043.1	82 23 12	262 22 35	⊡ 2½2	1,206.9
					148 10 09	328 09 31	△ Schoolhouse	2,347.0
					68 33 06	248 32 54	⊡ 2½3	432.6
⊡ 2½5	43 40 31.15	961.3	91 16 04.54	101.7	89 52 18	269 51 53	⊡ 2½5	793.6
					5 14 44	185 14 28	⊙ Brown	5,463.8
					265 34 04		⊙ Stoddard	3,984.4
⊡ 2½3	43 40 31.09	959.5	91 16 39.97	895.3	266 16 44		⊙ Stoddard	
⊡ 2½4	43 43 11.50	354.9	91 14 50.52	1,130.9	98 05 30	278 05 06	⊡ 2½4	760.0
⊡ 2½4	43 43 14.96	461.7	91 15 24.14	540.4	91 25 47	271 25 26	⊡ 2½4	698.7
⊡ 2½4	43 43 15.53	479.3	91 15 55.34	1,238.8	321 40 40	141 42 36	⊙ Stoddard	6,074.1
					91 06 01	271 05 39	⊡ 2½4	694.2
⊡ 2½4	43 43 15.96	492.6	91 16 26.35	589.9				
⊡ 2½5	43 45 40.41	1,247.2	91 14 10.42	233.1	94 36 17	274 35 50	⊡ 2½6	860.9
⊡ 2½5	43 45 42.65	1,316.3	91 14 48.78	1,091.1	94 43 02	274 42 46	⊡ 2½5	512.2
⊡ 2½5	43 45 44.01	1,358.3	91 15 11.60	259.5	211 07 24	31 09 07	⊙ Grandfather	6,448.9
					87 48 49	267 48 23	⊡ 2½5	848.3
⊡ 2½6	43 45 42.96	1,325.8	91 15 49.50	1,107.1				
⊡ 2½6	43 48 14.90	459.9	91 13 45.61	1,019.6	238 33 15	58 33 58	⊙ Grandfather	1,654.4
⊡ 2½6	43 48 17.25	532.4	91 15 12.94	289.2	85 26 27	265 25 50	⊡ 2½5	1,218.3
⊡ 2½6	43 48 14.12	435.8	91 16 07.04	157.4	82 00 25	262 00 08	⊡ 2½6	563.2
					259 00 12	79 02 33	⊙ Grandfather	4,657.9
					242 23 12		△ St. Joseph Spire	
					301 18 39		△ Brewery Cupola	
⊡ 2½6	43 48 11.58	357.4	91 16 31.99	715.1				
⊡ 2½7	43 50 41.32	1,275.3	91 16 26.61	594.3	89 12 11	269 11 37	⊡ 2½7	1,081.1
⊡ 2½7	43 50 40.83	1,260.2	91 17 15.00	335.1	300 50 53	120 54 02	⊙ Grandfather	7,095.2
					13 54 47	193 54 06	⊙ Root River	5,497.5
					99 23 40	279 23 14	⊡ 2½7	854.4
⊡ 2½7	43 50 45.34	1,399.3	91 17 52.74	1,178.0	298 34 14		⊙ Grandfather	7,897.2
					313 57 01		△ St. Joseph Spire	
					283 29 26		△ North Lacrosse Spire	
⊡ 2½9	43 53 06.12	188.9	91 18 07.75	173.0	60 44 24	240 43 58	⊡ 2½8	962.1
⊡ 2½9	43 52 50.89	1,570.6	91 18 45.35	1,012.3	60 26 16	240 25 49	⊡ 2½8	1,017.2
					122 00 13		Church Spire	
⊡ 2½8	43 52 34.63	1,068.8	91 19 24.98	557.7	250 27 25	70 31 58	△ Onalaska	9,323.6
					308 27 54	128 32 33	⊙ Grandfather	11,489.8
⊡ 2½8	43 55 27.33	843.5	91 20 39.55	882.4	57 40 14	237 39 54	⊡ 2½8	787.2
⊡ 2½9	43 55 13.09	422.5	91 21 09.37	209.1	52 45 14	232 44 53	⊡ 2½9	823.9
					28 46 51		Church Spire	
⊡ 2½8 = P. B. M. 182 and 183	43 54 57.53	1,775.6	91 21 38.76	864.8	346 56 12		⊙ Dresbach	
					226 47 16	46 51 04	⊙ Holmen	10,061.3
					276 14 20	96 20 26	⊙ Onalaska	11,842.1
					329 59 55		Water Tank	
⊡ 2½9	43 57 39.27	1,215.1	91 22 33.63	749.7	53 11 46	233 11 26	⊡ 2½8	825.3

□ 218	43	57	23.26	730.7	91	23	03.27	72.9	52	51	31	232	51	18	□ 210	702.9
									0	29	43	180	29	42	Dakota	1,741.2
□ 212	43	57	09.60	296.3	91	23	28.40	633.3	253	55	52	...			Holmen	10,174.3
									146	07	15	...			Trempealeau	...
□ 211	43	59	05.49	169.4	91	25	02.68	59.7	61	22	10	241	21	40	□ 211	1,124.8
									26	08	06	206	07	41	Richmond	1,855.6
□ 211	43	58	48.02	1,482.1	91	25	46.98	1,047.1	351	24	53	171	24	58	Richmond	1,139.6
									203	09	10	23	09	26	West Base	...
□ 212	44	00	42.35	1,307.1	91	27	47.63	1,061.0	42	20	08	222	19	41	□ 212	1,280.3
									241	59	53	...			Trempealeau	...
□ 213 = P. B. M. 176 and 177	44	00	11.69	360.8	91	28	26.34	586.9	231	34	22	51	35	20	Trempealeau	2,383.2

TABLE NO. 4.—*Approximate elevations of triangulation stations referred to the Mem datum as determined by vertical angles.*

Station.	Elevation.	Station.	El ti
	Feet.		*Fi*
Fruitland	609	Hard Times	
Muscatine	.....	Carruthers	
Campbell	782	Hair	
Hushey	728	Wyoming	
Martin	728	Fairport	
Hays	759	Lowry	
Deans Point	753	Perry	
Andalusia	672	Buffalo	
Bean	695	Anderson	
Kane	696	Beatty	
Davenport	717	School	.....
Rock Island	702	Moline	
McClellan	685	Gilberttown	
Race Track	700	Crow	
Watertown	683	Hampton	
Valley City	703	Fulton	
Crab Island	687	Sycamore	
Lower Base	587	Upper Base	
Le Claire	691	Rapids City	
Le Boone	719	Port Byron	
Hopson	707	Woodward	
Princeton	722	Cordova	
Wapsie	597	Evergreen	
Rocks	719	Marais D'Osier	
Camanche	715	Albany	
Clinton	.....	Ferris	
Lyons	723	Jack Green	
Elk River	828	Dyson	
Sabula	858	Bristol	
Savanna	891	Lainsville	
Miller	790	Apple River	
Green Island	801	Hanover	
Harrington	864	Blanding	
Rogers	818	Wise	1,
Smith	996	Horseshoe	1,
Gordons Ferry	1,036	Sinsinnawa	1,
Gratiots Grove	1,251	Hefferman	
Hubbard	1,111	Rickey	
Gassman	1,097	Catfish	
Convent	800	Lower Base	.....
Upper Base	.....	Dubuque	
Cutler	852	Schubert	
Freese	910	Maquoketa	
Fenley	904	Spechts Ferry	
Platte River	915	Potosi	
Sherrills Mound	1,207	Grant River	
Kratz	903	McCartney	
Rumpel	647	Sparks	
Waupeton	641	Joco	
Buena Vista	757	East Base	.....
Brown House	831	Spring Lake	
West Base	.....	Klinehunt	
Kirschbaum	991	Esmer	
Spoden	1,040	Jump	1,
Glen Haven	939	Langworthy	
Sandy Creek	994	Clayton	
Bagley	971	Paterson	1,
Clark	1,096	Drake	1,
Wisconsin Point	1,114	North McGregor	
Prairie du Chien	666	South Base	.....
Dousman	951	Hanging Rock	
North Base	.....	Lanka	1,
Picatee	964	Sioux	1,
Painted Rocks	925	Lynxville	1,
Oil Spring	1,027	Dagnon	1,
Madden	1,063	Heytmans	1,
Ferryville	1,039	Columbus	1,
Rush Creek	1,064	Cowles	1,
Wyburn	1,197	Battle Ground	1,
Kains	1,137	Upper Base	
Lower Base	631	Elgar	1,
New Albin	1,108	Genoa	1,
Reno	1,089	Stoddard	
Brown	1,087	Calvert	
Brownsville	1,119	Grandfather	1,
McDonald	1,221	Dresbach	1,
Root River	1,081	Holmen	
Onalaska	1,236	Beardsley	
Dakota	1,259	Richmond	1,
Trempealeau	1,153	West Base	
East Base	651		

TABLE NO. 5.—*Discrepancies between precise and ordinary levels.*

Between P. B. M's.	Distance.	Error.	Leveled by—
	Miles.	*Feet.*	
l 26	1¼	+0.13	C. A. Bonfils.
l 28	7½	— .08	W. H. Roper.
l 31	5	— .05	Do.
l 32	1	— .05	Do.
l 33	2	+ .05	Do.
l 34	2½	— .03	Do.
d 35a	3½	— .04	Do.
nd 36	4	— .09	Do.
d 37	1	.00	Do.
d 38	6½	— .09	Do.

TABLE NO. 6.—*Discrepancies between right and left bank levels.*

sing at stone line.	Distance.	Discrepancy.	River crossing at stone line.	Distance.	Discrepancy.
	Miles.	*Feet.*		*Miles.*	*Feet.*
	3	0.09	141	3	0.07
	3	.13	142	3½	.00
	3	.02	143	3	.04
	3	.17	144	3	.04
	4	.05	145	2	.02
	3	.06	146	4	.10
	3	.10	147	3	.07
	3	.12	148	3	.08

NO. 7.—*Descriptions and elevations of high-water marks leveled to in season of 1894.*

Description.	Year.	Elevation.
		Feet.
ation of warehouse at New Boston, Ill	1881	552.04
it southeast corner of A. J. Martin's house, on left bank, opposite head of Keg Island	1892	549.04
it southwest corner of Richard Gliddin's house, 300 meters above Martin's	1892	549.14
at residence of Esq. Walton, 7 miles below Muscatine, Iowa	1851	551.17
	1870	550.96
	1888	550.99
	1888	551.02
	1890	549.78
	1892	551.58
idence of R. H. Small, on right bank, 5½ miles below Muscatine, Iowa	1880	551.32
	1888	551.58
	1891	551.58
pier from Illinois side of Muscatine wagon bridge	1892	555.62
it H. Smith's house, 2½ miles below Muscatine, Iowa	1888	553.40
	1892	554.07
it G. B. Barrow's house, 2½ miles below Muscatine, Iowa	1888	553.66
	1892	554.26
uleton's house, 2 miles below Muscatine, Iowa	1870	553.27
	1880	553.55
	1881	553.67
works at Muscatine, Iowa	1881	554.80
pier from Illinois shore of Muscatine wagon bridge	1892	555.71
ite at Illinois end of Muscatine wagon bridge	1892	555.36
n front of J. Mackemer's store, at Fairport	1892	560.28
n upper end of Fairport, Iowa	1888	559.16
	1892	560.39
ear residence of Robert Johnson, opposite Montpelier, Iowa	1881	562.52
	1892	563.68
n abutment, three-fourths mile above Montpelier, Iowa	1892	562.06
mers' Home," 4 miles below Davenport, Iowa	1880	562.91
	1888	563.24
	1892	564.51

TABLE NO. 8.—*Slope of water surface in Mississippi River between successive stone lines from Davenport, Iowa, to Keithsburg, Ill.*

No. of stone line.	Location of line.	Elevation of water surface.	Total slope between lines.	Midstream distance between lines.	Slope per mile.
		Feet.	*Feet.*	*Miles.*	*Feet.*
148	¼ mile below Credit Island	548.06			
147	¼ mile above Linwood, Iowa	546.80	1.26	2.97	0.424
146	¼ mile below Buffalo, Iowa	545.71	1.09	2.85	.382
145	At Montpelier, Iowa	543.90	1.81	3.98	.455
144	At center of Island 326	543.15	.75	1.93	.389
143	¼ mile above Fairport, Iowa	541.61	1.54	3.18	.484
142	¼ mile below foot of Island 331	540.77	.84	2.84	.296
141	¼ mile below foot of Island 332	539.32	1.45	3.40	.426
140	1 mile below Muscatine wagon bridge	537.86	1.46	2.91	.502
139	3½ miles below Muscatine, Iowa	537.02	.84	3.26	.258
138	7 miles below Muscatine, Iowa	536.37	.65	2.89	.225
137	¼ mile above head of Island 346	535.26	1.11	2.75	.404
136	At Port Louisa, Iowa	533.65	1.61	3.80	.424
135	2¾ miles below Port Louisa, Iowa	532.76	.89	2.87	.310
134	2 miles above New Boston, Ill	531.72	1.04	3.00	.347
133	1 mile below New Boston, Ill	530.89	.83	3.12	.266
132	1 mile above Keithsburg, Ill	529.95	.94	2.74	.343

TABLE NO. 9.

DESCRIPTIONS OF BENCH MARKS FROM KEITHSBURG, ILL., TO NEAR ROCK ISLAND, ILL., WITH THEIR ELEVATIONS, IN FEET, ABOVE THE MEMPHIS DATUM.

[Mean Gulf level, preliminary value, is 8.13 feet above Memphis datum. L. B. signifies left bank and R. B. right bank.]

T. B. M. No. 1, L. B. Nail in root of tree, 3-foot elm, 4 meters from top of bar, about 1 mile below mouth of Edwards Creek and opposite sand bar. Elevation 539.56.

T. B. M. 2, L. B. Nail in root of tree on north side of 30-inch sycamore, 200 meters above Edwards Creek and opposite point of sand ridge. Elevation, 541.15.

T. B. M. 3, L. B. Wire nail in root of forked leaning willow tree, about 100 meters below stone line 133, between bluff and river. Elevation, 540.73.

T. B. M. 5. Wire nail in root of 4-inch oak sapling, about 15 meters from $1\frac{1}{4}^{1}$ and nearly on line with $1\frac{1}{4}^{2}$ and $1\frac{1}{2}^{3}$. Elevation, 584.01.

T. B. M. 1, R. B., is nail in root of 3-foot maple, north side. Tree stands among a lot of large elm trees, 10 meters back from bank, 1½ miles above $1\frac{1}{2}^{2}$. Elevation, 540.25.

T. B. M. 2, R. B., is nail in root of 12-inch willow tree, at top of bank; behind bar and a little above point opposite mouth of Edwards Creek. Elevation, 538.29.

Stone line 133.—One mile below New Boston, Ill.

$1\frac{1}{2}^{2}$ Tile and pipe 790.2 meters back of B. M. $1\frac{1}{2}^{4}$, on the edge of cultivated field belonging to Henry Ives; 22 meters north of the northwest corner of garden; to 8-inch white oak, 101°, 14.5 meters; to 15-inch hickory, 151°, 31.5 meters. Elevation: Cap on pipe, 583.77; bolt in tile, 579.77.

$1\frac{1}{2}^{2}$ Tile and pipe on left bank, on top of sand bluff, at the edge of the woods and in front of the New Boston cemetery; about 25 meters from the river; to 10-inch red oak, 5°, 15.5 meters; to 12-inch red oak, 164° 30′, 44 meters; to 12-inch red oak, 252°, 302 meters. Elevation: Cap on pipe, 604.49; bolt in tile, 600.47.

$1\frac{1}{2}^{3}$ Tile and pipe on right bank, 25 meters from shore, opposite B. M. $1\frac{1}{2}^{3}$; to 8-inch locust, 94° 30′, 73 meters; to 15-inch elm, 341°, 6.4 meters; to 30-inch elm, 281°, 8.8 meters. Elevation: Cap on pipe, 542.89; bolt in tile, 538.96.

$1\frac{1}{4}^{2}$ Tile and pipe on the back edge of a slough, 892.4 meters back of B. M. $1\frac{1}{2}^{2}$, and approximately on line with B. M.s' $1\frac{1}{2}^{3}$ and $1\frac{1}{2}^{3}$; to 12-inch elm, 28° 30′, 9.7 meters; to 12-inch black oak tree, 279° 30′, 7.5 meters; to 8-inch ash, 205° 30′, 9.9 meters. Elevation: Cap on pipe, 540.30; bolt in tile, 536.28.

High-water mark of 1881 is nail driven in brick foundation of warehouse at New Boston, Ill. (on which is also P. B. M. 22). Elevation, 552.06.

T. B. M. 3, R. B., is nail in root of 15-inch maple standing out in front of timber's edge, on point opposite New Boston (Sturgeon) Bay. Elevation, 540.36.

T. B. M. 5, R. B., is nail driven in root of 15-inch birch tree, at top of bank, about 800 meters below stone line 134, 30 meters above corner of wire fence. Elevation, 543.52.

T. B. M. 7, L. B., wire nail in root of 4-inch maple, 200 meters above mouth of Sturgeon Bay, 10 meters back from shore. Elevation, 541.418.

T. B. M. 9, L. B., wire nail in root of 18-inch maple, about midway between $1\frac{3}{4}$ and $1\frac{4}{4}$. Elevation, 542.77.

Stone line 134.—Two miles above New Boston, Ill.; one-fourth mile above the old Iowa City Landing.

$1\frac{1}{4}$ Tile and pipe 20 meters from the west edge of a swamp and 813 meters back of B. M. $1\frac{1}{4}$; to 15-inch ash, 16° 30′, 9.3 meters; to 15-inch willow, 79° 30′, 6.9 meters; to 12-inch birch, 238° 30′, 6.7 meters. Elevation: Cap on pipe, 540.28; bolt in tile, 536.26.

$1\frac{2}{4}$ Tile and pipe on left bank, 600 meters below a clearing, on a ridge between a wide sand bar and a narrow slough running parallel to the river, 10 meters from the natural river bank; to 18-inch maple, 319°, 14 meters; to 24-inch cottonwood, 63° 30′, 46 meters; to 12-inch willow, 269°, 11.2 meters. Elevation: Cap on pipe, 543.99; bolt in tile, 539.99.

$1\frac{3}{4}$ Tile and pipe on Iowa shore, 10 meters from bank, 600 meters below outlet, to Odessa Lake and just north of a dry slough; to 12-inch black oak, 43°, 175 meters; to 15-inch black oak, 297°, 8.7 meters. Elevation: Cap on pipe, 541.23; bolt in tile, 537.23.

$1\frac{4}{4}$ Tile and pipe on top of an old embankment, apparently a railroad dump, near southeast corner of field, 970 meters back of B. M. $1\frac{3}{4}$, and on line with B. Ms. $1\frac{3}{4}$ and $1\frac{4}{4}$; to 15-inch cottonwood, 283°, 9.3 meters; to 15-inch cottonwood, 38° 30′, 9 meters; to 20-inch cottonwood, 176°, 2.6 meters. Elevation: Cap on pipe, 550.84; bolt in tile, 546.82.

High-water mark of 1892.—Center of head of wire nail, in river side of 9-inch thorn tree, at southeast corner of house of A. J. Martin (assuming course of river to be south). Mr. Martin's house is on L. B., opposite head of upper Keg Island. Elevation, 549.04.

High-water mark of 1892.—Center of head of wire nail, in east side of 9-inch hickory tree, at southwest corner of house of Richard Glidden. There are two cuts in bark under nail. Mr. Glidden's place is on L. B., adjoining Mr. Martin, and 300 meters above it. Both marks were put in in morning of highest water in 1892; directions assume river to be north and south. Elevation, 549.14.

T. B. M. 10. Nail in root of leaning willow tree, about 14 inches in diameter, on edge of bank (L. B.), and about 1 mile above stone line 134; about 100 meters below chute, between upper and lower Keg islands. Elevation, 541.45.

T. B. M. 11, L. B. Wire nail in root of 18-inch ash at top of bank; about 800 meters above lower end of Turkey Island, and 200 meters above a Government light. Elevation, 542.47.

T. B. M. 6, R. B., is nail in root of 12-inch willow tree, three-fourths mile above $1\frac{1}{4}$; tree stands 50 meters below slough and 5 meters from top of bank, on Muscatine Island. Elevation, 545.47.

T. B. M. 7, R. B., is nail in top of stump of 16-inch willow tree, at top of bluff bank, 80 meters above mouth of dry slough, and about 2 miles above stone line 134. Elevation, 545.66.

Stone line 135.—About $2\frac{1}{2}$ miles below Port Louisa Landing.

$1\frac{1}{4}$ Tile and pipe on left bank, 842 meters back of B. M. $1\frac{1}{4}$, 180 meters southwest of J. R. Minor's field; to 20-inch black oak, 300°, 16.6 meters; to 15-inch elm, 201°, 14.6 meters; to 9-inch ash, 82°, 2.2 meters. Elevation: Cap on pipe, 542.79; bolt in tile, 538.78.

$1\frac{1}{4}$ Tile and pipe 10 meters from the river shore and 325 meters above C. H. Golles north fence; to 18-inch elm tree, 73°, 7.6 meters; to 30-inch cottonwood, 191°, 11.6 meters; to 10-inch black oak, 316°, 13.2 meters. Elevation: Cap on pipe, 544.73; bolt in tile, 540.70.

T. B. M. 8, R. B., is nail in root of 40-inch elm tree, at top of river bank, directly opposite head of Turkey Island, and about 1 mile above $1\frac{1}{4}$. Elevation, 545.33.

T. B.. M. 9, R. B., is top of upper of two nails driven horizontally into a 10-inch tree; tree stands 10 meters back from bluff bank at lower corner of field, one-half mile below Port Louisa, Iowa. Elevation, 546.01.

T. B. M. 12, L. B. Wire nail in root of 24-inch elm, on river side, one-fourth mile below a point opposite Port Louisa. Elevation, 544.30.

$1\frac{3}{4}$ Tile and pipe on Turkey Island, 8 meters from east shore and opposite B. M. $1\frac{3}{4}$; to 8-inch willow, 333°, 13 meters; to 18-inch maple, 76°, 15 meters; to 10-inch willow, 137°, 10 meters. Elevation: Cap on pipe, 543.22; bolt in tile, 539.21.

$1\frac{5}{4}$ Tile and pipe 1,091.7 meters back of B. M. $1\frac{5}{4}$, on the main shore, 10 meters from the river bank and 480 meters below W. Garrett's field; to 36-inch elm, 301°, 18 meters; to 48-inch elm, 126°, 8.5 meters. Elevation: Cap on pipe, 544.56; bolt in tile, 540.55.

Stone line 136.—Port Louisa, Iowa.

1¼ In woods opposite Port Louisa, on Bogus Island, 279 meters from river, 11 meters west of slough, about 45 meters above junction with another slough; to 18-inch elm, 287°, 13.7 meters; to 12-inch ash, 80°, 15.2 meters; to 12-inch ash, 128°, 21.5 meters. Elevation: Cap on pipe, 544.23; bolt in tile, 540.21.

1¾ Tile and pipe on Bogus Island, 35 meters from shore, in small open timber opposite Port Louisa, Iowa; directly opposite foot of small towhead; to 20-inch elm, 18°, 8.7 meters; to 8-inch triple elm, 137°, 4 meters; to 12-inch elm, 200°, 4 meters. Elevation: Cap on pipe, 544.88; bolt in tile, 540.87.

1¾ Tile and pipe in open spot, at corner of roads, on line of road running back from Port Louisa to the bluffs; on point where old house once stood, east of bridge over Muscatine Slough, 23 meters south of fence and 19 meters west of another fence; to 20-inch maple, 158°, 10 meters; to 25-inch maple, 103°, 15 meters; to 12-inch double maple, 43°, 9 meters. Elevation: Cap on pipe, 547.80; bolt in tile, 543.80.

1¾ Tile and pipe on line of wire fence, on south side of road running back from Port Louisa, 135 feet west of fence corner, at bend and junction of roads. Elevation: Cap on pipe, 547.01; bolt in tile, 542.95.

T. B. M. 13, L. B. Wire nail in coffee-bean tree 6 inches in diameter; on R. B. of Illinois Slough, about 10 meters north of stone line 136. Elevation, 546.46.

T. B. M. 14, L. B. Wire nail in large root (on river side) of 30-inch elm, on L. B. of Illinois Slough, about three-fourths mile above stone line 136. Elevation, 546.44.

T. B. M. 15. Wire nail in root of 3-foot forked elm, on L. B. of Illinois Slough, 4 meters from top of bank; about 1 mile below head of Bogus Island and 100 meters from an old log barn. Elevation, 545.82.

T. B. M. 10, R. B., is nail in root of 16-inch birch tree, on top of bank at mouth of upper side of dry slough, about 1 mile above Port Louisa. Elevation, 541.21.

T. B. M. 11, R. B., is nail in root of 11-inch elm, standing 10 meters back from bank of river, about 1¼ miles above Port Louisa. Elevation, 545.27.

T. B. M. 12, R. B., is nail in root of 18-inch white oak, on river side of tree. Tree stands on bank and is about 50 meters below Government light and three-fourths mile below head of Bogus Island. Elevation, 545.26.

T. B. M. 13 is nail in root of 30-inch cottonwood, on river side of tree, at top bank, and about opposite head of Bogus Island. Elevation, 546.01.

T. B. M. 14, R. B., is nail in root of 36-inch elm tree, at top of bank. Tree is large of any in immediate vicinity; opposite middle of small island and about 2,000 me above 1¾; tree stands out more prominently than any other. Elevation, 545.25.

T. B. M. 15 is nail in root of 16-inch birch tree, at top of bank, 10 meters be small hickory, with high-water marks 15 meters below P. B. M. 25; one-half below stone line 138; nail on river side of tree. Elevation, 549.12.

High-water marks.—1851: Spike inside of 10-inch hickory; elevation, 551.17. Spike inside of 10-inch hickory; elevation, 550.96. 1888: Spike inside of 10- hickory; elevation, 550.99. 1888: Spike inside of 5-foot elm; elevation, 551.02. Spike inside of 10-inch hickory; elevation, 549.78. 1892: Spike inside of 5-foot elevation, 551.58. These high-water marks on group of trees in front of dwe formerly owned by Esquire Walton and are said to be correctly given. Informa given by Esquire Walton's son.

T. B. M. 17, L. B. Wire nail in root of 9-inch double ash tree, on L. B., about half mile above stone 1¾. Tree is on top of bank. Elevation, 545.88.

T. B. M. 18, L. B. Wire nail in root of 24-inch honey locust, on river side of on L. B. of Illinois Slough, about 1 mile above stone line 137; 300 meters below Barkis Island. Elevation, 545.47.

Stone line 137.—Three miles above Port Louisa, one-fourth mile above Island 346.

1¼ Tile and pipe on Illinois bank, 50 meters from left bank of Illinois Slough, 85 meters in front of large slough and 600 meters above mouth of slough; to 36- inch elm, 359°, 15 meters; to 24-inch soft maple, 114°, 13 meters; to 36-inch elm, 207°, 7.9 meters. Elevation: Cap on pipe, 547.33; bolt in tile, 543.30.

1¾ Tile and pipe in clearing on Barkis Island (346), about one-fourth mile above foot of island, 25 meters from bank of river, 70 meters from bank of Illinois Slough; to 12-inch soft maple, 168°, 14 meters; to 24-inch cottonwood, 35°, 19.7 meters; to 15-inch ash, 226°, 19 meters; to 10-inch soft maple, 130°, 7.8 meters. Elevation: Cap on pipe, 546.61; bolt in tile, 542.59.

1¾ Tile and pipe on right bank, 40 meters from river bank and 400 meters above foot of Barkis Island; a wagon road is 18 meters west of stone; to 18-inch cottonwood, 29°, 5.4 meters; to 30-inch elm, 319°, 21.6 meters; to 15-inch locust, 242°, 12.7 meters; a 48-inch sycamore, 5 meters from bank, is nearly in line with the B. M. and elm tree; sycamore not blazed. Elevation: Cap on pipe, 548.90; bolt in tile, 544.87.

T. B. M. 20, L. B. Wire nail in root of 12-inch leaning willow; 200 meters bel stone line 138. Elevation, 545.12.

Stone line 138.—About 7 miles below Muscatine, Iowa; across middle of first to head below Blanchard Island.

1¾ Tile and pipe 1,149.5 meters back of B. M. 1¾, on land of C. R. Woodward, 250 meters south of east and west road. It is in low ground on prairie; a small lake is 40 meters east of B. M. A cultivated piece of ground which rises about 5 feet higher than the prairie is about 50 meters south. B. M. is also midway between two old wagon roads that join 15 meters south. Elevation: Cap on pipe, 543.55; bolt in tile, 539.57.

1¾ Tile and pipe on Illinois shore, 160 meters above C. R. Woodward's north fence and about 500 meters above foot of slim towhead below lower end of Blanchard Island; 25 meters from chute; to 36-inch elm, 252°, 23.3 meters; to 15-inch soft maple, 23°, 5.8 meters; to 36-inch elm, 150°, 8 meters. Elevation: Cap on pipe, 547.98; bolt in tile, 543.98.

1¾ Tile and pipe 30 meters from river bank, on Muscatine Island; 1 meter west of E. Beatty's front yard fence; to 15-inch coffee-bean tree, 200°, 4 meters; to 24-inch honey locust, 80°, 6 meters; to northeast corner Beatty's house, 94°, 30 meters. Elevation: Cap on pipe, 555.92; bolt in tile, 551.90.

T. B. M. 16, R. B., is nail in root of 6-inch sycamore stump, about 2,400 meters above stone line 138. Elevation, 548.57.

T. B. M. 18, R. B., is nail in root of 10-inch cottonwood tree, in edge of willows, 2 meters above stone line 139, 30 meters from water's edge. Elevation, 546.23.

High-water mark 1888 and 1891, elevation, 551.59; high-water mark 1880, elevation, 551.32; high-water marks on 20-inch burr oak, on place of H. R. Smull, about 100 meters west of house, 2 meters west of road. T. B. M. is in root of same tree; elevation T. B. M., 549.36; about 1¼ miles above stone line 138.

T. B. M. 23. Nail in fork of double willow, on top of bank, on L. B. of Blanchard Slough, 25 meters north of large oak, 100 meters north of large slough, about 2 miles above stone line 138. Elevation, 550.19.

T. B. M. 24. Wire nail in stump of 20-inch maple, 20 meters back from bank, about 200 meters below house and stone line 139. Elevation, 549.35.

Stone line 139.—About 3½ miles below Muscatine, Iowa. 1¾ Tile and pipe in open spot, 100 meters below mouth of Copperas Creek, 30 meters back of narrow island, 315 meters above fence corner, 4 meters east of wagon road; line crosses small island about 80 meters below dwelling house on main bank of river; to 14-inch burr oak, 160°, 11.2 meters; to 40-inch double cottonwood, 215°, 21 meters; to 36-inch elm, 315°, 9.9 meters. Elevation: Cap on pipe, 550.63; bolt in tile, 546.62.

1¾ Tile and pipe on Blanchard Island, 1 mile below head of ridge, 100 meters from river, 60 meters from slough on the west, and 25 meters from small slough on east; to 10-inch linn tree, 280°, 11 meters; to 10-inch hackberry, 48°, 7 meters; to 26-inch elm, 141°, 20 meters. Elevation: Cap on pipe, 552.62; bolt in tile, 548.61.

1¾ Tile and pipe on property of D. Freeman, at intersection of two wire fences, one north and south, the other east and west, 170 meters north of east and west road; two lone trees, a cottonwood and a birch, stand south of B. M.; to south line of section 22, 182 meters south; to levee, 156 meters east; to 4-inch birch tree, 343°, 6 meters; to 8-inch cottonwood, 352°, 37 meters. Elevation: Cap on pipe, 550.60; bolt in tile, 546.57.

1¾ Tile and pipe on Muscatine Island, along east and west hedge, on property belonging to R. F. Parmelee; to center southeast ¼, section 21, along hedge, 90°, 12.5 meters. Elevation: Cap on pipe, 558.15; bolt in tile, 554.18.

T. B. M. 25. L. B., in fork of double elm 9 and 18 inches, about 8 inches above ground, 600 meters above head of Blanchard Island, 10 meters back from top of bank. Elevation, 549.08.

High-water mark of 1892 is paint mark on down-river pier of first couple of tubular piers from Illinois side of Muscatine wagon bridge; high-water mark is upper edge of paint mark. Elevation, 555.62.

T. B. M. 19, R. B., is nail in root of 10-inch cottonwood tree, standing about 10 meters in front of levee and directly in front of dwelling, about 300 meters below head of Blanchard Island. Elevation, 548.44.

High-water mark of 1888 is marked by railroad spike in side of tree in front of Mr. H. Smith's dwelling, about 2¼ miles below Muscatine. High water of 1892 is marked by wire nail in side of same tree (30-inch elm). Elevation: 1888, 553.40; 1892, 554.07.

High-water marks on 6-inch oak tree at top of bank, on river side of road, in front of G. B. Barrow's dwelling, 2¼ miles below Muscatine, one-fourth mile above Mr. Smith's place. Elevation: 1888, 553.66; 1892, 554.27.

High waters of 1870, 1880, and 1881 are marked by the top of posts set at top of bank in front of Mr. H. Hazelton's dwelling, about 2 miles below Muscatine and one-fourth mile above Barrow's place. Elevation: 1870, 553.27; 1880, 553.55; 1881, 553.67.

T. B. M. 20, R. B., is nail in root of 16-inch maple at foot of willows, opposite lower end of island, that 1¾ is on; tree directly in front of dwelling. Elevation, 547.31.

T. B. M. 21, R. B. Nail in elbow of short, 6-inch maple, about 18 inches from ground; 200 meters below Hershey's sawmill. Elevation, 549.54.

Stone line 140.—In lower part of Muscatine, Iowa.

1¼° Tile and pipe, opposite lower Muscatine lumber yards, on ridge between two sloughs; 7 meters west of one slough and 12 meters east of another slough, 100 meters above their junction; 530 meters from the river bank; 486 meters from B. M. 1¼°; to 24-inch pin oak, 138°, 5.8 meters; to 10-inch ash, 198°, 6.6 meters; to 36-inch four pronged ash, 355°, 7.2 meters. Elevation: Cap on pipe, 549.20; bolt in tile, 545.17.

1¼° Tile and pipe on left bank on ridge, back of hollow, 50 meters from river bank, 70 meters below mouth of slough back of island; opposite Muscatine, Iowa; about 1 mile below Muscatine Bridge; to 8-inch walnut, 168°, 2 meters; to 14-inch burr oak, 184°, 11.2 meters; to 18-inch elm, 64°, 5.3 meters; to 8-inch walnut, 275°, 3.2 meters. Elevation: Cap on pipe, 555.44; bolt in tile, 551.48.

1¼° Tile and pipe on towhead opposite lower part of Muscatine, Iowa; 200 meters below head of towhead; 50 meters from west bank and 150 meters from east bank; to 10-inch willow, 145°, 30.5 meters; to 8-inch maple, 68°, 27 meters; to 8-inch maple, 220°, 49 meters. Elevation: Cap on pipe, 548.77; bolt in tile, 544.77.

1¼° Tile and pipe in southern part of Muscatine, Iowa, north of lumber yards; it is on a side hill, in meadow belonging to Weltz, along a north and south fence, 58 meters north of Bowling Green road; to 10-inch oak, 260°, 7 meters; to 10-inch oak, 139°, 1.3 meters; to 8-inch oak, 326°, 8.3 meters. Elevation: Cap on pipe, 655.64; bolt in tile, 651.61.

T. B. M. 23, R. B., is railroad spike in switch block, about 100 meters below Oatmeal Company's warehouse. Elevation, 560.67.

Rod held directly over letter H. High-water mark of 1881 is cut on east side of waterworks building, in top of stone foundation. Elevation, 554.80.

B. M. 44. McKenzie is top of southeast corner stone bed of pump cylinder of waterworks. Elevation, 555.51.

16-foot mark in well is cut in brick wall of cistern, which is connected with river by 20-inch pipe. Elevation, 16-foot mark, 553.50.

Rod held on 15-foot mark of gauge of waterworks section reads from 5 to 16 feet; is nailed to 12 by 12 foot pier, 15 meters below warehouse; gauge section is a 4 by 4 inch scantling, 15-foot mark on gauge. Elevation, 552.93.

Rail elevation taken on a line with northeast end of Muscatine depot; depot on north side of track; base of rail, 558.29; top of rail outside track most distant from depot, 558.64; top of rail inside rail of inside track, 558.73. Top of water table of depot southeast corner, about 8 inches above platform. Elevation, 559.19.

B. M.——(of city engineer) is top of northeast corner of west abutment of Front Street Wagon Bridge, about 50 meters northeast of depot. Elevation, referred to city datum and as given by city engineer, 300.37. Elevation, 556.47, Memphis datum.

Gauge cut in Iowa side second pier of bridge. It is on southwest corner of second pier, reads from 5.4 to 18.4 feet. Elevation: High water of 1892, 555.95; high-water mark reads on gauge 18.4 feet.

City B. M. is top of southeast corner of east pier on north side of railroad track, Muscatine High Bridge. Referred to city datum and as determined by city engineer. Elevation, 302.74; elevation by Memphis datum, 558.79.

1892 high-water mark on lower pier of third pair of tubular piers from Illinois side of Muscatine wagon bridge. Elevation, 555.71.

1892 high-water mark on downstream side of Illinois end of wagon bridge, on small house or tollgate. Elevation, 555.36.

Stone line 141.—About 1½ miles above Muscatine Bridge; 100 meters below foot of Island No 332.

1¼¹ Tile and pipe in timber 80 meters from river bank, on left bank, about one-fourth mile below head of Island No. 334; to 15-inch ash, 115°, 7.3 meters; to 15-inch burr oak, 46°, 5.5 meters; to 15-inch burr oak, 271°, 9 meters. Elevation: Cap on pipe, 553.64; bolt in tile, 549.59.

1¼¹ Tile and pipe one-half meter north of south right-of-way fence of Chicago, Rock Island and Pacific Railroad; 192 meters west of Bridge No. 93; 18 meters west of switch where siding runs to tile factory; 14.5 meters south of railroad track. Elevation: Cap on pipe, 553.35; bolt in tile, 549.32.

1¼¹ Tile and pipe 1 meter north of hedge fence, along wagon road, on property of Capt. John W. Anderson, and 1 meter east of east line of John Berry's property; to 12-inch wild cherry tree, 34°, 3 meters. Elevation: Cap on pipe, 606.52; bolt in tile, 602.43.

T. B. M. 29, L. B. Wire nail in body of leaning willow, 24 inches in diameter, about 18 inches above ground; 30 meters from top of bank; 1½ miles above stone line 141. Tree is double. Elevation, 549.74.

T. B. M. 30, L. B. Wire nail in root of 4-foot forked elm; two 8-inch forks near the ground; on top of bank and 200 meters above dike. Elevation, 549.90. One mile below stone line 142.

T. B. M. 31, L. B. Wire nail in root of 6-inch red haw, 4 meters from top of bank; opposite foot of island; 100 meters below stone line 142. Elevation, 551.91.

T. B. M. 25, R. B., is nail in root of 8-inch willow, about 1,000 meters above $1\frac{1}{2}$. Elevation, 548.10.

T. B. M. 26, R. B., is nail in root of 30-inch cottonwood; nail about 3 feet from body of tree; tree is in open spot at top of bank, about 2,000 meters above stone line 141. Elevation, 549.38.

T. B. M. 27, R. B., is highest point of south end of large bowlder, 10 meters in front of timber line; in front of house and opposite clearing on island, about 800 meters above T. B. M. 26. Elevation, 545.63.

T. B. M. 28, R. B., is point on southeast corner of lower stone of west abutment of Bridge No. 78, on Chicago, Rock Island and Pacific Railroad, at stone line 142. Elevation, 550.95.

Stone line 142.—100 meters below foot of Island No. 331.

$1\frac{1}{2}$ Tile and pipe on left bank, on line of north and south fence, one-fourth mile south of river, opposite foot of Island No. 331, on land of N. D. Ricket; at foot of bluff, 30 meters above fence corner; tree 25 inches in diameter, 40°, 4.5 meters. Elevation: Cap on pipe, 574.60; bolt in tile, 570.59.

$1\frac{2}{2}$ Tile and pipe on property of Mrs. McDonald, $4\frac{1}{4}$ miles above Muscatine, 30 meters below small creek crossed by Railroad Bridge 78, and 660 meters above Welland Creek; 5 meters east of southeast corner of house, 1 meter east of large apple tree. Elevation: Cap on pipe, 580.12; bolt in tile, 576.08.

T. B. M. 32, L. B. Wire nail on root of 24-inch cottonwood, 25 meters back from top of bank, three-fourths mile above stone line 142, 40 meters above mouth of small creek, 400 meters below dam, on wagon road. Elevation, 549.18.

T. B. M. 33, L. B. Wire nail in root of forked leaning 12-inch willow, about one-half mile below Fairport, 10 meters below wire fence, opposite house. Elevation, 549.52.

T. B. M. 30, R. B., is nail in root of 8-inch cottonwood, at top of river bank, opposite point of bar, at head of Geneva Island. Elevation, 553.57.

Base of rail taken on a line with east end of depot at Fairport, Iowa; south rail nearest depot. Top of rail, 568.71; base of rail, 568.35.

T. B. M. 31 is nail in root of 30-inch sycamore on east side of tree. Tree standing at foot of North and South street, in Fairport, Iowa. This is the farthest street east. A 5-foot elm stands about 40 meters up the river. Elevation, 552.

T. B. M. 32 is highest point on north end of small bowlder that rises about one-half foot above surface of ground, in front of upper end of willows, and about 50 meters below stone line 143. Elevation, 545.55.

High-water mark of 1892 is a spike driven in east side of 16-inch sycamore standing in front of J. Mackerner's grocery store. Elevation, 560.28.

High-water mark of 1892 and 1888 is marked on 4-foot elm, 40 meters east of foot of street. Farthest street east in Fairport, Iowa. Just above T. B. M. 31. 1888 mark is chopped place in northwest side of tree. Elevation, 559.16. 1892 mark is marked by spike in west side of tree. Elevation, 560.39.

Stone line 143.—One-fourth mile above Fairport, Iowa.

$1\frac{3}{3}$ Tile and pipe on Illinois bank, about one-fourth mile back from river bank, 1 meter south of rail fence at foot of bluffs, along wagon road; B. M. is 250 meters west of small gully, about 700 meters west of Mr. Martin's house on land of Thomas Cole; to 8-inch black walnut, 310°, 17.4 meters; to 10-inch white oak, 324°, 20 meters; to 12-inch white oak, 55°, 43 meters. Elevation: Cap on pipe, 599.50; bolt in tile, 595.54.

$1\frac{3}{2}$ Tile and pipe 1 meter north of south fence of Muscatine and Davenport wagon road, about one-fourth mile above Fairport, Iowa; 295 meters east of east line of street, which is the eastern boundary of Fairport; to 10-inch white oak, 193°, 23.5 meters; to 10-inch black walnut, 90°, 30 meters. Elevation: Cap on pipe, 603.15; bolt in tile, 599.13.

T. B. M. 34, L. B. Wire nail in root on river side of 24-inch triple-pronged willow; 500 meters above Island 328; 400 meters below large sand bar; 2 meters from top of bank and 10 meters from wagon road. Elevation, 551.31.

T. B. M. 33, R. B., is nail in root of 10-inch walnut tree about 75 meters west of B. M. $1\frac{1}{2}$; 3 meters inside of fence; 8 meters from road; tree leans slightly. Elevation, 611.54.

T. B. M. 34, R. B., is nail in root of 30-inch cottonwood tree, 1 mile above Fairport, Iowa. Elevation, 549.88.

T. B. M. 35 is highest point of large round bowlder, 400 meters below stone line 144, 8 meters in front of willows and opposite lower end of small island. Elevation, 549.37.

Stone line, 144.—About $3\frac{1}{4}$ miles above Fairport, Iowa, near center of Island No. 326.

$1\frac{4}{4}$ Tile and pipe on property of D. Hayes; on or very close to section line between sections 27 and 28, township 17, range 4 west; on bench at foot of bluffs;

140 meters back from Andalusia Slough; to 10-inch slippery elm tree, 78° 30′, 4 meters; to 12-inch oak, 4°, 20 meters. Elevation: Cap on pipe, 618.40; bolt in til 614.34.

1¼ Tile and pipe on north side of Island No. 325, opposite a wagon road comi down the bluff on Iowa side and about 400 meters below Island No. 326; 25 mete from bank of river; to 18-inch maple, 86°, 8.3 meters; to 15-inch maple, 216°, 4 meters; to 15-inch maple, 6.2 meters. Elevation: Cap on pipe, 556.19; bolt in ti 552.24.

1¼ Tile and pipe on property of J. B. Barr, one-half meter west of section li between section 21 and 22, about 150 meters from railroad track, on sidehill at ed of timber, 10.7 meters south of intersection of north and south section line, a south line of J. C. Fitchner; to 18-inch white oak, 75°, 5.6 meters; to 18-inch wh oak, 264°, 7.9 meters; to 10-inch hickory, 154°, 9.5 meters. Elevation: Cap on pi 641.65; bolt in tile, 637.64.

T. B. M. 36, R. B., is nail in root of 24-inch elm on river side; elm tree 2 met above stone line 144, between wagon road and river. Elevation, 552.99.

T. B. M. 37, R. B., is highest point of a rectangular rock in front of P. B. M. This bowlder has ringbolt fastened in it. Elevation, 546.47.

P. B. M. 35 on bridge No. 52, Chicago, Rock Island and Pacific Railway. Elevati 571.56. (See Report of 1883, p. 140.)

T. B. M. 38, R. B. Nail in root of 30-inch elm tree, standing at top of bank meters above stone line 145. Elevation, 555.12.

T. B. M. 36, L. B. Wire nail in root of 20-inch twin cottonwood, about 1 m above stone line 144, 300 meters above a house. Elevation, 552.80.

T. B. M. 37, L. B. Wire nail in root, on river side of double-elbowed maple, 12 8 inches, just opposite slough between Islands 328 and 325, about 800 meters be stone line 145; 50 meters above cabin. Elevation, 552.60.

Stone line 145.—At Montpelier, Iowa.

1¼ Tile and pipe on bench, about one-fourth mile above slough between Isl 324 and 325; on cleared grassy spot at edge of timber; 90 meters back of wa road; 100 meters back of Andalusia Slough; to 18-inch oak, 76° 30′, 15 meters 10-inch oak, 330° 30′, 9 meters; to 10-inch box elder, 190° 30′, 33.5 meters. El tion: Cap on pipe, 638.16; bolt in tile, 634.13.

1¼ Tile and pipe in Montpelier, Iowa; on street running north from depot; o site and in line with south side of schoolhouse, one-half meter east of wire fe on west side of street; to southwest corner of schoolhouse, 263° 30′, 22 meters. vation: Cap on pipe, 611.68; bolt in tile, 607.65.

T. B. M. 38, L. B. Wire nail in root of 9-inch birch, about 1 mile above stone 145; 115 meters below corner of fence, on top of bank, 50 meters above small gully. Elevation, 553.49.

High-water marks are on 18-inch cottonwood on place of Robert Johnson on L about 120 meters northeast of house, 3 meters from top of bank, and near corn fence. Elevation: 1881, 562.52; 1892, 563.68.

Base of rail taken on line of east end of depot, north rail, Montpelier, Iowa. vation: Base of rail, 569.44; top of rail, 569.80.

T. B. M. 39, is point of bowlder halfway between shore and edge of willows meters above wire fence and one-half mile above Montpelier, Iowa. Elevation, 54

T. B. M. 40, R. B., is nail in root of 30-inch cottonwood, 30 meters back from side and 1½ miles above Montpelier. Elevation, 551.84.

High water of 1892 marked by spike driven in east abutment of Chicago, R Island and Pacific Railway Bridge No. 45. Elevation, 562.06.

T. B. M. 41, R. B. Nail in root of 30-inch elm. In front of gate at intersecti of wire fences, and 2 miles above Montpelier. Elevation, 553.45.

T. B. M. 42, R. B., is nail in root of 18-inch birch, 6 meters from wagon road, meters from fence, in front of southeast corner of yard (farm house). House is *ju* east of strip of timber running at right angles to river; 1 mile below stone line 14 Elevation, 557.85.

T. B. M. 43, R. B., is nail in root on northeast side of 20-inch elm, standing 1 meters from railroad track toward river and on stone line 146. Elevation, 559.

Stone line 146.—Three-fourths mile below Buffalo, Iowa.

1¼ Tile and pipe one-fourth mile from river, one-half mile below Andalusia, Ill. in Rock Island wagon road; 1 meter north of south fence, on land of Ellen Boney; 10 meters west of Edgington road. Elevation: Cap on pipe, 593.02; bolt in tile, 589.

1¼ Tile and pipe on property of W. L. Clark, 1 meter south and 2 meters east center of southeast quarter of section 21; 400 meters from river, 250 below creek and 1,450 meters below depot, Buffalo, Iowa; to 3-inch haw tree (not blazed), 202 8.2 meters. Elevation: Cap on pipe, 624.37; bolt in tile, 620.37.

The abutment on which P. B. M. 35 A is located is 21 meters east of east abu ment of bridge No. 45, as at present located. The bridge has been changed since B. M. 35 A was put in and is now about 30 meters west of old position. Elevatio 564.04. (Report of 1883.)

Base of rail taken on line with east end of depot, north rail, Buffalo, Iowa, Chicago, Rock Island and Pacific Railway. Elevation: Top of rail, 567.14; base of rail, 566.77.

T. B. M. 44, R. B., is nail in south side, in root of 30-inch elm tree standing at top of bank; 50 meters in front of rail fence; along top of bank is wagon road; about 1 mile above Buffalo, Iowa. Elevation, 555.75.

T. B. M. 45, R. B., is nail in root of 30-inch elm, on east side, near top of bank, 100 meters below stone line 147. Tree is leaning. Elevation, 556.79.

T. B. M. 41, L. B., on bowlder. About 1 mile above stone line 146, bowlder egg-shaped, projects about 1 foot above ground, and has dark cap and ring. Elevation, 547.92.

Stone line 147.—One-fourth mile above Linwood (Iowa) Hotel.

$1\frac{1}{2}$ Tile and pipe on Illinois shore, 1 meter north of south fence on Milan and Andalusia wagon road, about 350 meters east of A. H. Mosher's house; 34 meters west of north and south line which runs through center of northeast quarter of section 25; to 6-inch burr oak, 161°, 6 meters; to 15-inch walnut, 85° 30′, 48 meters. Elevation: Cap on pipe, 605.12; bolt in tile, 601.11.

$1\frac{1}{2}$ Tile and pipe 1 meter east of west fence of road on section line dividing sections 23 and 24; 2 meters north of north fence on Davenport road; about one-fourth mile above hotel at Linwood, Iowa; 20 meters from river bank; to 20-inch burr oak, 298°, 34.3 meters. Elevation: Cap on pipe, 569.71; bolt in tile, 565.70.

T. B. M. 42, L. B. In body of 9-inch leaning willow, three-fourths mile above stone line 147, on edge of bridle path, 20 meters above foot of large snag; nail 2 inches above ground. Elevation, 553.60.

T. B. M. 43, L. B. Wire nail in root on 10-inch birch, 1 mile below stone line 148; opposite head of Horse Island; just below a rocky point, on river side of tree. Elevation, 558.89.

T. B. M. 46, R. B., is nail in root of 8-inch willow, in edge of willows; 200 meters below head of Island; 1¼ miles above stone line 147. Elevation, 554.64.

T. B. M. 47, R. B., is nail in north side of 12-inch haw tree, in root; tree near a very large bowlder, 1 mile below $1\frac{1}{3}$. Elevation, 559.81.

Stone line 148.—Three miles below Davenport, Iowa; about one-half mile below Credit Island.

$1\frac{1}{3}$ Tile and pipe on island formed by Rock River, opposite Rockingham, Iowa. In elm grove, 50 meters from river bank, 300 meters below John Albright's field; to 18-inch hackberry, 238°, 15 meters; to 24-inch oak, 344°, 11 meters; to 36-inch elm, 348°, 25.5 metres; to 30-inch elm, 62° 30′, 19.5 metres. Elevation: Cap on pipe, 561.89; bolt in tile, 557.87.

$1\frac{1}{3}$ Tile and pipe at Rockingham, Iowa, 15 meters from river, one-half meter east of fence on Davenport wagon road; 136 meters northeast of Homann's south line and 380 meters below wagon road running west; to 10-inch maple, 208°, 4 meters; tree marked IX facing river. Elevation: Cap on pipe, 565.74; bolt in tile, 561.76.

$1\frac{1}{3}$ Tile and pipe one-half meter west of fence on Davenport wagon road, along bluffs; 1,509.5 meters back from B. M. $1\frac{1}{3}$; to northwest corner Fairview schoolhouse district No. 1, 229°, 35.5 meters; to 18-inch black oak tree, 112°, 15.7 meters; to 30-inch walnut, 330°, 24.1 meters; to 12-inch locust, 353°, 7.5 meters. Elevation: Cap on pipe, 626.86; bolt in tile, 622.96.

T. B. M. 48, R. B., is nail in root on east side of 18-inch poplar tree. Tree is one farthest east in a row of six; in front of a residence on which is a sign "Farmers' Home," at end of lane, about 800 meters above $1\frac{1}{3}$. Elevation, 563.30.

High water of 1880–1892, by knife cut in southeast corner of Farmers' Home building, on framework above foundation. Elevation: 1880, 562.91; 1888, 563.24; 1892, 564.51.

T. B. M. 49, R. B., is nail in fork of small 6-inch willow directly opposite head of towhead in slough, behind Credit Island, one-half mile below Credit Island. Elevation, 554.28.

T. B. M. 50, R. B., is nail in root of 30-inch elm on southeast side of tree standing on fence line, 100 meters from river, on a line with upper end of Credit Island and chimneys of sawmill in Rock Island, 100 meters above one house and 25 meters below another. Elevation, 565.47.

T. B. M. 44, L. B. Wire nail in body of 10-inch leaning willow tree, 11 meters from top of bank, 3 meters west of foot path on west side of Rock River, 400 meters northwest of flood gate; tree is blazed. Elevation, 556.45.

B. M. Canal is top of northeast corner of east wall of Hennepin Canal lock, at mouth of Rock River, 2 miles below Rock Island, Ill. B. M. is not marked. Elevation, 563.88.

TABLE NO. 10.—*Lowest gauge readings, Mississippi River, 1894.*

ST. LOUIS TO FORT JACKSON.

Station.	Lowest gauge reading.		Correction for error found in gauge.	Corrected gauge reading.	Elevation of low water above Cairo datum.	Date of inspection.
	Date.	Reading.				
		Feet.	*Feet.*	*Feet.*	*Feet.*	
St. Louis	Feb. 3	0.20	.....	0.20	400.43	Nov. 7.
	Dec. 29	1.00	.....	1.00	401.23	
Grays Point	Feb. 3–6	3.70	.....	3.70	324.98	Dec. 5.
	Dec. 29	5.10	0.000	5.10	326.38	
Cairo	Nov. 3	2.88	—0.067	2.81	293.65	Nov. [illegible].
Belmont	....do	0.78	+0.008	0.79	287.93	Dec. [illegible]
New Madrid	Nov. 2	1.60	+0.074	1.67	277.39	D[illegible].
Cottonwood Point	Nov. 2–7	—0.75	—0.70	—1.45	249.17	Dec. [illegible]3.
Fulton	Nov. 5–7	1.64	+0.169	1.81	230.36	Dec. [illegible]2.
Memphis	Nov. 6–8	—1.40	.....	—1.40	202.57	Oct. 19.
Mhoon Landing	Nov. 6–10	—7.20	—0.038	—7.24	174.24	Nov. 30.
Helena	Nov. 8	—2.23	.....	—2.23	159.75	Oct. 12.
Sunflower Landing	Nov. 6–8	—0.40	+0.059	—0.34	146.74	Nov. 29.
Mouth of White River	Nov. 7–8	2.65	.....	2.65	131.38	Oct. 16.
Arkansas City	Nov. 8	—2.3	—0.059	—2.36	114.08	Nov. 28.
Greenville	Nov. 8–9	—1.1	+0.087	—1.01	106.99	Nov. 27.
Lake Providence	Nov. 9, 11–12	—4.25	.....	—4.25	85.37	Oct. 10.
Vicksburg	Nov. 11–14	—5.25	—0.06	—5.31	60.73	Dec. 7. Sept. 10.
St. Joseph	Nov. 10–13	—7.70	—0.036	—7.74	45.00	Nov. 26.
Natchez	....do	1.00	1.00	1.00	37.89	Sept. 19. Dec. 10.
Red River Landing	Nov. 12	—0.25	.....	—0.25	23.60	Sept. 24.
Bayou Sara	Nov. 11–14	1.2	—3.933	—2.73	21.22	Nov. 25.
Baton Rouge	Nov. 14	0.45	.....	0.45	20.51	Sept. 28.
Plaquemine	....do	—1.00	+0.060	—0.94	20.12	Nov. 24.
Donaldsonville	Nov. 11	1.00	.....	1.00	20.48	Sept. 29.
College Point	Nov. 14	—0.96	+0.042	—0.91	20.33	Nov. 24.
Carrollton	Nov. 15	—0.05	.....	—0.05	20.86	Oct. 2.
Fort Jackson	Nov. 12, 14	0.3	0.00	0.3	19.56	Nov. 21.

APPENDIX 5.

REPORT OF CAPT. GRAHAM D. FITCH, CORPS OF ENGINEERS, UPON OPERATIONS IN THE FIRST AND SECOND DISTRICTS.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., June 1, 1895.

COLONEL: I have the honor to submit the following report of operations in the first and second districts for the year ending May 31, 1895. These districts were in charge of Capt. S. W. Roessler, Corps of Engineers, until January 7, 1895, upon which date I relieved him and assumed charge by virtue of paragraph 2, Special Orders, No. 295, Headquarters of the Army, Adjutant-General's Office, December 17, 1894.

FIRST DISTRICT (CAIRO TO FOOT OF ISLAND NO. 40, 220 MILES).

Columbus, Ky. (21 miles below Cairo).—The work of improvement at this point consists of five spur dikes of brush and stone, built in 1889 and 1890 to protect a portion of the bank along the city front which was threatening to cave. The unprotected intervals of bank between the floor mats of the spurs have caved slightly during the past few years, without, however, seriously threatening the stability of the spurs. No further work is at present required.

Hickman, Ky. (36 miles below Cairo).—A continuous mattress of brush and stone 930 feet long was placed in 1889 to stop the caving of the bank in front of the town. In 1892 the protection above low water was strengthened by placing upon it a layer of riprap stone 10 inches thick, and was extended downstream by a new mattress to cover a pocket which had been scoured out below the end mat. At the close of the last fiscal year there remained an unexpended balance of $41,031.55. The river and harbor act of July 17, 1894, required the expenditure of this balance. Work was begun September 17, 1894. The underlying brush of the 1889 revetment, being entirely decayed, was repaired with a 10-inch layer of riprap; the revetment was extended downstream by a mattress 630 feet long and 250 feet wide; the projecting clay points were graded, and the bank for 630 feet below the work of 1889 was paved

from low-water line to the top of the bank with a layer of riprap 12 inches in thickness. The work was completed November 3, 1894, except the paving near the top of the bank, which was done between January 21 and February 2, 1895, after the river had risen to the 30-foot stage. Further details are given in the accompanying report of Assistant Engineer William Gerig. No further work is at present deemed necessary.

New Madrid, Mo. (71 miles below Cairo).—In July and August, 1893, the bank opposite the upstream portion of the town was revetted. The revetment consisted of a fascine mattress, 900 feet long and 250 feet wide, of auxiliary mattresses, and of a shore paving extending from the water line to the level of the 27-foot stage. The river and harbor act of July 17, 1894, contained a special appropriation of $20,000 for continuing this improvement. Work was begun on October 10, 1894, the project being to extend the existing revetment as far downstream as the funds would permit. One fascine mattress of the type fully described in previous reports was constructed. It was 725 feet long and 250 feet wide, and overlapped the first mattress by about 25 feet. One narrow connecting mattress was also necessary. The bank had a good slope and no hydraulic grading was necessary. It was dressed by hand preparatory to paving. The average thickness of the paving was 12 inches (4 inches of spalls and 8 inches of riprap) and it extended from the low-water line to about the 30-foot stage. The length of bank paved was 700 feet. The cost of the work was as follows:

River mattress, 725 linear feet, 1,812.5 squares	$11,479.15
Connecting mattress, 88 squares	791.87
Paving, 700 linear feet, 80,766 squares	6,179.02
Expended, preparing plant and for property	1,549.96
Total	20,000.00

Further details are given in the accompanying report of Assistant Engineer William Gerig.

It is proposed to extend this work downstream far enough to protect the whole town of New Madrid against further encroachments by the river as soon as funds shall have been appropriated by Congress.

Plum Point Reach (147–186 miles below Cairo).—Under this title works of improvement have been executed at various localities between Daniels Point and Craighead Point, Arkansas, a distance by river of about 20 miles. They are fully described in previous reports.

During the year ending May 31, 1895, the improvement of the reach has been continued by the completion of the Ashport Bend revetment, by the completion of the Bullerton Towhead revetment, and by the repairing of the dam in Gold Dust Chute.

The delivery of stone was begun in July, 1894. A formal contract was entered into with Messrs. J. S. McTighe & Co. for delivering 34,900 cubic yards of riprap and 8,700 cubic yards of spalls on barges at Plum Point Reach at the following-named prices: For stone unloaded by the contractor, $1.67 per cubic yard for riprap and $1.45 per cubic yard for spalls; for stone unloaded by the Government, $1.47 per cubic yard for riprap and $1.25 per cubic yard for spalls. Under the above contract 28,529 cubic yards of riprap and 3,770 cubic yards of spalls were delivered, the extreme low water and several accidents to towing steamers and barges having seriously interfered with the delivery. An additional supply of 6,596 cubic yards of riprap and 988 cubic yards of spalls was obtained by open-market purchase. Of this quantity 1,119 cubic yards riprap were delivered at Plum Point on owners' barges at a cost of $1.70 per cubic yard, and the remainder was loaded at the quarries on Government barges at an average cost of 42½ cents per cubic yard for riprap and 42½ cents per cubic yard for spalls, the towing being done by the Government.

Contracts were also entered into with Messrs. Hunter & Frey for brush at $1.07 per cord and for poles at $1.50 per cord delivered on Government barges.

For other materials, such as wire, wire strand, rope, etc., obtained under contract, see abstract of proposals herewith.

Revetment, Ashport Bend.—This revetment was begun in 1882 and resumed in 1891 at the upper limit of caving, and was extended downstream 14,920 feet during the years 1891, 1892, and 1893, leaving 1,380 feet of bank at the lower end of the bend unprotected. The revetment was completed in 1894. Two river mats were constructed, one 1,085 feet and the other 294 feet long, each 260 feet wide. The mats were of the fascine type. Mat construction was begun October 2 and completed October 27. The bank was graded to a slope of 3 on 1 from the zero line up to the two-third stage. Paving on a 4-inch spall foundation was carried up to the 17-foot stage. The work was finally completed on December 19. Further details are given in the accompanying report of Assistant Engineer Aug. J. Nolty. No further work is considered necessary here under present conditions of river and bank.

Revetment, Bullerton Towhead.—The original revetment here, built in 1882–1884, was 10,000 feet long. An outlying sand bar protecting it was washed away in 1892, and in 1893 the revetment was breached in many places. As, in addition, the mattresses were but 100 feet wide, it was decided to renew the entire revetment. In 1893, by the placing of four mattresses, each 250 feet wide, 4,080 feet of new revetment was constructed. During the past season the new revetment was continued downstream by the construction of five river mats and fourteen connecting mats, all of the fascine type. The river mats were all 260 feet wide, and were of the following lengths: 1,015, 986, 1,016, 978, and 1,354 feet. The bank was graded to a slope of 3 on 1 from the zero line up to the 20-foot stage and then paved. Work was begun September 27, 1894, and completed January 30, 1895. Further details are given in the accompanying report of Assistant Engineer Aug. J. Nolty. No further work is considered necessary here under present conditions of the river and bank.

The cost of the work at Ashport Bend and Bullerton Towhead was as follows:

River mats, $13.436 per linear foot	per square..	$5.160
Connecting mats	do.....	5.90
Grading, 90 cents per linear foot	per cubic yard..	.038
Paving, $6.16 per linear foot	per square yard..	.928

Cost per linear foot of completed revetment, $21.74.

Dam in Gold Dust Chute.—In 1892 the Mississippi River Commission approved a project for the construction of a solid dam of brush and stone, 16 feet high above low water, across Gold Dust Chute at its narrowest point. The dam was built in 1893 and is fully described in the last Annual Report. The dam settled considerably and two breaks occurred during the high water of 1894. During the past season the dam was rebuilt to the 14-foot level and the breaks repaired. The stone for the work was delivered during the summer on the bank at Elmot Bar. Work was begun November 1, 1894, and completed January 18, 1895. A wooden tramway 3,000 feet long was built across Elmot Bar, at a cost of $1,675.32, and then, on November 16, was begun the construction of a submerged fascine mat in a large hole washed out below the break near the Tennessee shore. The mat was completed December 8 and fully ballasted by January 5, 1895. It contained 942½ squares and cost $13.09 per square. The repairing of the dam was begun on December 5 and completed on January 16. It comprised 287,748 cubic feet and cost $0.0688 per cubic foot. There was used on the entire work 4,461 cubic yards of stone, costing $7,449.93, and 6,234 cords of brush, costing $13,157.82. The total cost of the season's work was $35,980.33. Further details are given in the accompanying report of Assistant Engineer B. B. Gordon. Whether any further work will be required it is as yet impossible to state.

Other works.—At Daniels Point 5,300 linear feet of revetment was constructed in 1889 and repaired in 1891 and 1892. Since 1892 nothing has been done here and the work has been steadily deteriorating, the revetment above low water line being badly wrecked. During the coming season it is proposed to renew the present upper-bank revetment, about 5,000 feet in length, by removing the old decayed brush work and replacing it with a riprap paving 10 inches thick from zero to the 20-foot contour, after regrading wherever necessary; it is also proposed, as the bank has been caving, to extend the revetment about 5,000 feet farther upstream by the construction of normal fascine mats 260 feet wide.

The revetment at Fletchers Bend was commenced in 1884 and added to at various times until its present length of 16,500 feet was reached in 1891. The revetment is continuous from the upstream end for a distance of 12,000 feet; below this the mattresses were laid in four detached blocks, each 1,100 feet long, with intervals of 300, 400, and 500 feet between them. These detached mattresses have been undermined and injured at the ends by the caving of the unprotected bank between them, and it is proposed during the coming season to remedy this by the construction of short stone spur dikes. On March 23, 1895, a large cave occurred in the bank at the lower end of Fletcher's Bend revetment and a portion of the United States warehouse, stored with boilers, engines, pumps, and other machinery, was undermined and lost. The remainder was removed and the warehouse moved back 300 feet.

Between Upper and Lower Osceola bars there are two chutes leading into Osceola Chute. This latter was closed by a number of dikes during 1882, 1883, and 1884, which caused heavy fillings in the chute, though it is still open at high stages. The decaying and breaking down of the dikes and the caving above the upper end of Lower Osceola Bar are tending to throw more water down Osceola Chute during high stages. As further caving would probably be disastrous, it is proposed during the coming season to construct a revetment from ahead of Lower Osceola Bar across the chutes to lap on the bank of Upper Osceola Bar, a distance of 3,750 feet. As the channel depth along this front is only about 16 feet at low water, river mats 200 feet in width will be sufficient with the bank paved to about mid stage.

Results at Plum Point Reach.—The least depth recorded during the year in the reach was over the Plum Point crossing, where only 6 feet was found at extreme low water. This was in November, the gauge being 2.3 feet below the zero of 1879. Shortly afterwards a new crossing developed at this place with 7 feet depth.

LEVEES.

Lower St. Francis levee district.—This district extends from Point Pleasant, Mo., to the mouth of the St. Francis River, a distance by river of 218 miles. The Commission's allotment of $88,000 for this levee district for the fiscal year ending June 30, 1895, less 10 per cent, has been expended in extending northward about 4 miles the levee near Barfield, Ark., thus connecting the United States levee of the previous season with a levee recently built by the Arkansas levee district from the Missouri State line southward. The work was divided into three contracts and each contract was awarded to the lowest bidder, Mr. Ernest Hyner, at the following prices: For the lower contract, 18 cents per cubic yard; for the middle contract, 16 cents per cubic yard, and for the upper contract, 15 cents per cubic yard.

Work was begun and completed as follows: Lower contract, begun July 16, 1894, completed February 26, 1895; middle contract, begun July 4, 1894, completed March 23, 1895; upper contract, begun July 4, 1894, completed March 9, 1895.

The grade is 4 feet above calculated high water of 1882. Total yardage was 490,898.5 cubic yards.

The allotment of $88,000 for the fiscal year ending June 30, 1896, less 12 per cent, is to be expended in extending southward the levee near Stewarts Landing. The work for the first 9 miles was advertised October 24, 1894, and bids opened November 17, 1894. The contract for the whole, about 535,000 cubic yards, was awarded to Forrest & Co., of Memphis, at 9½ cents per cubic yard. The balance of the work, extending southward to join the State levee near Gayoso, or as far as funds will permit, was advertised November 21 and bids opened December 3, 1894. The contract, estimated at 244,000 cubic yards, was awarded to T. Mike at 8.19 cents per cubic yard. Forrest & Co., began work December 1 and have completed up to grade (3 feet above high water) to date 157,000 linear feet of levee. T. Mike began work April 4, 1895, and has completed to date 5,100 linear feet of levee, near the Arkansas State line.

On January 19, 1895, I was authorized to use the 1895 high-water reserve fund, Lower St. Francis district, for levee construction, and on January 23, 1895, the Secretary of War approved an allotment of $2,000 to that district from the unallotted balance for 1895 for the same purpose. This money was to be utilized in assisting the Missouri Levee Board in closing a 3-mile gap, known as the Tyler Gap, near the Arkansas State line. Work was begun under the Missouri Levee Board March 1, 1895, the Government agreeing to pay 4 cents per cubic yard for completed work. At present 6,200 linear feet of levee has been completed, being 52 per cent of the entire work.

A special appropriation of $75,000 was made in the last river and harbor act for the prevention of the formation of a cut through to the St. Francis River by the action of the overflow water from the Mississippi River. This appropriation has been expended in constructing a levee, known as the Walnut Bend Levee, 6 miles long, in Lee County, Ark. (in Second district), beginning 275 miles below Cairo. Eventually it will constitute a part of the St. Francis Basin levee system. The work was let in four contracts, as follows: Contract No. 1, at 13.49 cents per cubic yard, to Robert Johnsen; contract No. 2, at 9.94 cents per cubic yard, to T. H. Rice; contract No. 3, at 13.24 cents per cubic yard, to Robert Johnsen; contract No. 4, at 16.99 cents per cubic yard, to Robert Johnsen. Contracts Nos. 1, 3, and 4 were awarded on October 22, 1894, and contract No. 2 on November 2, 1894.

The levee was completed April 2, 1895. It was built to a grade 2 feet above high water of 1882. The total yardage was 527,808 cubic yards.

	Cubic yards.
Aggregate contents of levees May 1, 1894	1,148,900
Added by the United States between May 1, 1894, and May 25, 1895	1,261,846
Added by the local districts between May 1, 1894, and May 25, 1895	1,226,337
Total to May 25, 1895	3,637,083

SECOND DISTRICT (FOOT OF ISLAND NO. 40 TO MOUTH OF WHITE RIVER, 180 MILES).

Revetment, Hopefield Bend (227-230 miles below Cairo).—The revetment in this bend is over 3 miles long, extending from Mound City to Hopefield Point. From Mound City down to about 2 miles above Hopefield Point the old revetment is protected by an outlying sand bar, and no repairs have in consequence been required. The lower 2 miles of the revetment was extensively repaired in 1890, 1891, 1892, and 1893. During the extreme low water of last fall much hitherto submerged work became exposed to view and showed the necessity of further repairs. Work was accordingly begun November 20 and completed December 15. A length of bank 5,800 feet was repaved along the low-water line from 5 feet below to 10 feet above the zero contour; one connecting mat was also constructed where undermining had occurred. The

total cost of this work was $5,493.75, of which $5,144.11 was expended in paving and $351.64 in constructing the connecting mat. Further details are given in the accompanying report of Assistant Engineer W. M. Rees. At present along the upper 6,300 linear feet of bank there is very little upper-bank revetment remaining, but as this portion is not exposed to strong currents no serious caving is anticipated. Along the lower 10,000 linear feet there has been a nearly complete renewal of the work since 1890, with wide river mats and paved upper banks. Here the current is quite strong during flood stages, and as the bank is very easily eroded and some weak spots probably remain there is danger of further caving.

Memphis Harbor (230 miles below Cairo).—The river frontage of the city extends from the mouth of Wolf River to the Kansas City and Memphis Railroad Bridge, a distance of 13,300 feet. At the beginning of the fiscal year the only portion of this bank remaining unprotected was 3,800 feet between the lower end of the citizens' dikes and the upper end of the bridge company's revetment. It was proposed during the working season of 1894 to revet the bank from the dikes southward as far as the funds would permit. Work was begun November 13 and completed January 10. But one river mattress was constructed, 1,260 feet long and 300 feet wide, of the fascine type. The slope above it was paved with a layer of broken stone about 1 foot in thickness and extending from 1 foot below the zero stage to the 21-foot stage of the river. Brush and poles were obtained by contract at $1.07 per cord for brush and $1.50 per cord for poles, delivered on Government barges 50 to 70 miles below the work. Stone was obtained by contract at $1.48 per gross ton for riprap and $1.33 for spalls, delivered on Government barges at West Memphis. The cost per linear foot of mattress 300 feet wide was $18.09; per square of 100 square feet, $6.03. The paving cost $0.956 per square yard. The total cost of revetting 1,260 feet of bank was $34,526.65; the cost per linear foot of revetment was $27.40. Further details are given in the accompanying report of Assistant Engineer W. M. Rees. There yet remains about 2,400 feet of bank to be revetted.

Of the $50,000 appropriated for Memphis Harbor August 7, 1894, $10,000 was to be used in dredging at the mouth of Wolf River, in the discretion of the Secretary of War. This it is proposed to do during the coming low-water season, dividing the work of removing snags and other obstructions and the work of dredging so as to secure a navigable channel from the mouth of Wolf River upward as far as the money available will allow, not extending beyond the new railroad bridge.

Nonconnah Rock (236 miles below Cairo).—This rock is located opposite the mouth of Nonconnah Creek, 3 miles below Memphis Bridge. Since 1890 the low-water channel of the river has occupied a narrow span of 700 feet between the rock and the Tennessee shore, thus forcing all craft, especially heavy tows, to pass uncomfortably close to the rock at medium and at low stages. In the fall of 1893 an unsuccessful attempt was made to remove the rock by dynamite. The height of the rock was, however, reduced only 3½ feet, bringing it to the level of 1-foot stage below low water. A project for its complete removal will be submitted later.

Helena Harbor (306 miles below Cairo).—The work of improvement consists of a continuous revetment 600 feet long and of 5 spur dikes constructed in 1889-90 to protect 3,000 feet of caving bank in front of the town. No further work is recommended at the present time.

LEVEES.

In the second district are included the lower part of the lower St. Francis levee district reported upon above, also the upper Yazoo levee district on the left bank and the upper and lower White River levee districts on the right bank.

Upper Yazoo levee district (244 to 365 miles below Cairo).—The Commission's allotment of $100,000 for the fiscal year ending June 30, 1895, was expended in raising and enlarging the existing levee from Commerce (267 L) southward for a distance by levee of 20 miles. This work was rendered necessary by the levees constructed to close the St. Francis Basin.

The work was let in four contracts, as follows: Section 25–29, John G. Sessions, at 11½ cents per cubic yard; section 30–33, McLaughlin Bros., at 12½ cents per cubic yard; section 34–37, Arnold & De Garis, at 16.98 cents per cublic yard; section 38–44, McLaughlin Bros., at 13½ cents per cubic yard.

Work was begun on Sessions's contract May 1, 1894, and finished March 5, 1895; on McLaughlin Bros.' upper contract work was begun April 1, 1894, and finished November 15, 1894; on Arnold & De Garis's contract work was begun May 10, 1894, and finished December 15, 1894; on McLaughlin Bros.' lower contract work was begun March 7, 1894, and completed December 24, 1894. All the work on these four contracts was built to a grade 5 feet above the flood of 1882.

The Commission's allotment of $100,000 for the fiscal year ending June 30, 1896, is to be expended, less 12 per cent, in enlarging the existing levees for the 15 miles above Commerce and in the construction of the "Delta Loop" or "Moon Lake" levee. The work near Commerce was let October 5, 1894, to the following parties:

Section 1-4, John G. Sessions, at 10 cents per cubic yard; section 5-7, Timothy Sullivan, at 10.95 cents per cubic yard; section 8-10, John G. Sessions, at 9.95 cents per cubic yard; section 18-22, Moore & Welsh, at 9.98 cents per cubic yard.

Work has been begun on all of these contracts except the third. On the first contract there has been completed to date 1,100 linear feet of levee, or 5 per cent; on the second contract, 5,200 feet, or 27 per cent, and on the fourth contract, 6,800 feet, or 26 per cent.

During the past ten years caving has occurred in the vicinity of Delta Landing, Mississippi, until last year at one point the bank was within 110 feet of an angle in the levee. It was accordingly decided to construct a loop line 8,426 feet long, crossing the foot of Moon Lake. The district levee board constructed 3,500 feet of the heaviest work near the middle. This left a gap at each end of the loop which was closed by the Government. This work was let October 5, as follows: Station 3326–3342 (enlargement) and Station 3342–3355 (new work), T. S. Aderholdt, at 10.40 cents per cubic yard; Station 3390–3426+26 (new work), W. A. Shippey, at 8.99 cents per cubic yard.

Aderholdt began work November 16, 1894, and has completed to date 1,500 feet of levee, or 78 per cent. Shippey began work December 1, 1894, and completed his contract May 1, 1895.

	Cubic yards.
Aggregate contents of levees May 1, 1894	9,000,345
Added by the United States between May 1, 1894, and June 27, 1895	973,906
Added by the local district between May 1, 1894, and June 27, 1895	460,143
Total to June 27, 1895	10,434,395

Upper White River levee district (306 to 340 miles below Cairo).—The Commission's allotment of $53,000 for this district for the fiscal year ending June 30, 1895, less 10 per cent, has been expended in extending the existing levee near Modoc, Ark., southward about 4 miles. The work was let in three contracts as follows: Upper contract, Arnold & De Garis, at 16¼ cents per cubic yard; middle contract, Timothy Sullivan, at 10.99 cents per cubic yard; lower contract, Forrest & Co., at 10.45 cents per cubic yard.

Work on the upper contract was begun in May, 1894, and completed March 1, 1895. Work on the middle contract was begun in June, 1894, and completed April 13, 1895. Work on the lower contract was begun in May, 1894, and completed April 23, 1895.

The grade in each case is practically 4 feet above the local high water, based upon a theoretical water line connecting Helena, Ark., with Sunflower, Miss.

The Commission's allotment of $53,000 for this district for the fiscal year ending June 30, 1896, less 12 per cent, is to be expended, first, in extending southward about 2 miles the recently completed levee just mentioned; second, in constructing a levee near Helena, about seven-tenths of a mile long, to protect the head of the system. The first work was let to Moore & Welsh December 31, 1894, at 12½ cents per cubic yard. They began work March 16, 1895, and have completed to date 20,000 cubic yards, or 13½ per cent of their contract. The Helena levee was let December 31, 1894, to Forrest & Co., at 9⅛ cents per cubic yard. They have not begun work.

	Cubic yards.
Aggregate contents of levees May 1, 1894	1,643,297
Added by the United States between May 1, 1894, and May 25, 1895	443,228
Added by the local districts between May 1, 1894, and May 25, 1895	16,507
Total to May 25, 1895	2,103,032

Lower White River levee district (340 to 385 miles below Cairo).—The Commission's allotment of $75,000 for this district for the fiscal year ending June 30, 1895, less 10 per cent, was expended in enlarging the Big Henrico levee and in extending the upper end of the system northward about 3 miles. The work of enlargement was let April 16, 1894, to C. A. Winter, at 12.98 cents per cubic yard. He began work on June 11, 1894, and completed his contract September 11, 1894. This levee was raised to a grade of 2 feet above high water of 1890, funds being insufficient to raise it to a 3-foot grade, as originally contemplated. The work of extension was let in two contracts, as follows: Station 1307–1392, J. S. McTighe & Co., at 15½ cents per cubic yard; Station 1392–1456, J. B. Lewis & Co., at 15.95 cents per cubic yard.

Work on the first contract was begun August 20, 1894, and completed December 21, 1894. Work on the second contract was begun May 22, 1894, and completed April 6, 1895. Both levees were built to a grade of 4 feet above a potential high-water plane of uniform slope connecting the high-water mark of 1890 at Helena with that at Sunflower.

The Commission's allotment of $75,000 for this district for the fiscal year ending June 30, 1896, less 12 per cent, is to be expended as follows:

(1) In enlarging the existing levee near Henrico, Ark., from Station 0 to 237+76.

(2) In enlarging the existing levee between Henrico and Laconia, Ark., from Station 284 to Station 504.

(3) In continuing northward the levee constructed during the past season in bend of Island 65 from Station 1456 as far northward as the funds will permit.

Bids for the above work were opened May 4, 1895, and the work awarded to the following lowest bidders: Station 0-237+76, 105,000 cubic yards, W. A. Shippey, at 8 cents per cubic yard. Station 284-504, 132,000 cubic yards, W. A. Shippey, at 8.44 cents per cubic yard. Station 1456 northward, 181,000 cubic yards, J. C. Hodge, at 13½ cents per cubic yard.

	Cubic yards.
Aggregate contents of levees May 1, 1894	1,630,811
Added by the United States to May 25, 1895	477,899
Added by the local district to May 25, 1895	0
Total to May 25, 1895	2,108,710

A map of the levees in the first and second districts accompanies this report, giving completed effective levees, new levees under contract, old levees, gaps, and grades.

SURVEYS, GAUGES, AND EXAMINATIONS.

The surveys, etc., made since June 1, 1894, include, besides the annual low-water survey of Plum Point Reach, the examination of shoal crossings in the first and second districts, and the usual low-water discharge observations, the following surveys, namely: Of Hickman Front, of Fletchers Bend, of Memphis Front, of Gold Dust Chute, of Wolf River, of Hopefield Bend, of Old Town Bend, of Bullerton Towhead, of New Madrid Front, of Daniels Point, and of Osceola Bar.

PLANT.

The *Minnetonka* on September 19, 1894, struck a submerged snag and sank. She was successfully raised October 11, and then towed to Mound City, Ill., where she was taken out on the ways and received practically a new hull, besides other extensive repairs. The work was done under contract with the Mississippi Valley Marine Railway and Dock Company, and cost $7,449.01. In April, 1895, all repairs were completed and she is now in very good condition.

During February and March, 1895, the *Titan* was extensively repaired. She received two new outboard cylinder timbers, new foundation and deck under both engines, new fantails, new cutting strake all around, etc.; had cabins and engines repaired and wheel rebuilt. She is now in good condition.

The *H. M. Graham* was repaired in March and April, 1895, receiving new deck beams and new deck under engines and boilers, and repairs to roof, fantail, wheel, engines, and capstan. She is good for one year's further service.

The tug *Itasca* and the launch *H. L. Abbot* received minor repairs. They are both in good condition.

For various repairs, some minor and some extensive, to the machine-shop boats, hydraulic graders, pile drivers, quarter boats, and barges, I would refer to the appended report of Assistant Engineer Aug. J. Nolty, where they are given in detail.

EXPERIMENTAL DREDGE.

At the time of the last annual report all the machinery connected with the dredge had been accepted, except the Allis jet pump. After the substitution by the makers of a new wheel or runner, this pump was again tested, and working up to the requirements, was accepted.

In order to adapt the dredge for the actual work of cutting channels, certain changes were made in the arrangements of the machinery, the principal being the connection of the Edwards pump with the water-jet suction end, originally designed for use with the Allis pump. This did away with the use of the Allis dredging pump and the Edwards pump suction. The Allis jet pump was used to stir up the material at the end of the suction pipe, which it did in a satisfactory manner, discharging six 2½-inch diameter streams under a head of from 18 to 21 feet. The kinking of the floating discharge pipes, due to the reaction of the discharged stream, was overcome by placing a little beyond the end of the last pipe and normal to it an iron plate, called a baffle plate, against which the stream impinged. This solved the problem in a very satisfactory manner. By constructing this plate with movable vanes or rudders the pipe line can also be deflected sideways.

Early in July the dredge and tenders were sent to St. Louis, Mo., where, after making some minor changes, experiments were continued under the immediate supervision of Col. Henry Flad. Only one channel-cutting trial was made; in this 4,108 cubic yards, measured in place, was excavated in nineteen and one-half hours, actual pumping, or at the rate of 210 cubic yards per hour. The material excavated was sand, containing some black mud and small driftwood, the latter having a tendency to clog up the suction inlets where the current was slack.

On August 11 the dredge was sent to Liberty Island to continue the experiments in a locality containing clear sand and strong current, but before these were begun it was decided to change the site to Cherokee Crossing, 88 miles below Cairo, as at this place there were two channels, and the experiments could be made without interfering with navigation. Here the channel was improved for a length of about 6,000 feet, but the quantities excavated were not determined. The information gained was principally as to methods of handling the dredge and regulating the supply and discharge of material. The deflection of which the 530 linear feet of pipe was capable was not sufficient to prevent the material from washing back into the channel dredged.

Experiments were conducted at the above locality from September 5 to October 10, when the dredging plant was sent to Flora Creek Crossing, just above Cape Girardeau, Mo. Here the water was very shoal and navigation was almost completely suspended in consequence. The locality was favorable for a practical test, as the length of the shoal was but 1,600 feet, with 3¾ to 4 feet of water over it and a deep pool below for discharging the dredgings.

Between October 19 and 26 a channel wide enough for the passage of steamboats and tows was cut to a depth of 6½ feet of water, the time actually employed in dredging being but forty-nine and one-half hours.

Eight steamboats, most of them with tows, passed through the channel in the two days following its completion. A few days later, however, a steamer with three loaded barges grounded at both ends, broadside across the channel, remaining there for some time; the water shoaled in one place to less than 4½ feet. The dredge again opened it up, and for the balance of the season steamboats continued its use without difficulty.

To determine the capacity of the pump, percentage of sand, etc., a barge was fitted up, into which the pump could discharge. After several delays, due to improper working of the valve connecting the barge with the discharge pipes, the tests were finally made. The general results obtained are as follows:

Nine tests were made through 547 linear feet of 30-inch diameter discharge pipe. The velocity through the pipe varied from 11 to 13 feet per second.

Percentage of sand from actual measurements of sand and water varied from 5.63 to 12.45.

Cubic yards of sand per hour varied from 491 to 905, with an average for the nine tests of 679 cubic yards.

Seven tests were made through 1,002 linear feet of 30-inch pipe, with velocity of from 7½ to 10¾ feet per second.

Percentage of sand from 5.23 to 12.17, and cubic yards per hour from 335 to 629, with an average for the seven tests of 479 cubic yards.

Upon the completion of these tests this boat was laid up, and as the period of experiment is considered to be ended, plans have been made to adapt it to permanent use. The following changes are now in progress:

(1) The construction of a cabin on the boat for the accommodation of the crew.

(2) Changing the positions of the pumps and engines to reduce the length of the suction pipe.

(3) Remodeling the winding engines to give slower motion to the feed and arranging all levers and gauges in a pilot house, so that the handling of the dredge will be under the charge of one operator.

(4) Placing on board an electric-light plant and a machine shop.

These changes will be completed in time for next season's work.

For further details, see report of Assistant Engineer C. W. Sturtevant and the table of tests with measuring barge.

NEW DREDGE.

At a meeting of the Mississippi River Commission August 30, 1894, the following resolution was passed:

"That the secretary be directed to prepare at once, under the direction of the committee on dredges, a circular, setting forth the conditions under which dredging on the bars of the Mississippi at low water is contemplated by the Commission, the object to be attained, the working capacity considered desirable in a dredge for the purpose, with such other particulars as may be of use in giving full information upon the nature and character of the problem, and transmit the same to such engi-

neers, contractors, and builders of dredges as he shall know or can learn of who are qualified to deal with the subject, inviting informal plans and suggestions as to the methods and machinery best adapted to the work; and that the committee on dredges be requested to submit at the next meeting of the Commission its recommendations as to the letting of a contract for a dredge in addition to the one provided for at the last meeting of the Commission."

In reply to the circular communications were received from three companies, representatives of which appeared before the Commission at their meeting in November, 1894, submitting preliminary plans and giving a general description thereof.

These firms were then invited to prepare full drawings and specifications for a dredging plant to comply with the requirements as set forth in the following resolution, passed by the Commission November 10, 1894, to wit:

"That the three companies who have already sent communications to the committee on dredges, in reply to their circular, to-wit, the Bucyrus Steam Shovel and Dredge Company, the New York Dredging Company, and the American Hydraulic Dredging Company, be invited to prepare full drawings and explain all the features of their proposed dredge and dredging plant, together with bids giving the price for which they will furnish to the Government one completed dredge ready for pumping, including the dredge hull, pumps, engines, suction pipes with cutters or other device, discharge pipe and all other apparatus necessary for pumping sand, and for other appliances which they may consider necessary, besides the above named, for disposing of the sand and operating the dredge. This dredge shall have an estimated capacity of 1,600 cubic yards per hour. The bidder may add a separate estimate for any device or appliances whose use he may desire to urge.

"Each bidder shall also bind himself, in case his plan is accepted, to deliver the dredge and dredging plant on or before August 1, 1895, and in case of noncompletion on that date, there shall be deducted from the contract price $250 for every day after that date required for completion.

"Each company furnishing such plans to the committee on or before the 10th day of December shall receive in payment therefor the sum of $1,500.

"From the plans submitted the committee shall select the one which is, in their opinion, best adapted to the work to be done, taking into account not only the cost of the separate parts, but also the methods proposed for operating it.

"The following requirements are considered to be necessary in the construction and operation of any dredge, and shall be inserted in the specifications accompanying the contract:

"*Requirements for a dredge with an estimated capacity of 1,600 cubic yards of sand per hour.*—The hull must have a steel frame, strongly braced and so bulkheaded as to prevent sinking in case of the filling of any two compartments. It shall be covered with five-sixteenths-inch steel plates, with three-eighths-inch plates at angles and exposed places, such as the water line. The deck shall be one-fourth inch thick. When fully equipped for work, and with a supply of coal for twenty-four hours' operation, the draft must not exceed 4 feet 6 inches. Its width should not exceed 40 feet.

"The dredge must also be fully and specially provided with the means of a straight upstream movement, with one or more suctions in front, which can cut to 20 feet below the surface of the water, and will make a cut wide enough for the passage of the hull of the dredge, and one or more discharge outlets through the stern, with an equal number of floating pipe lines or pipes supported by pontoons, each 1,000 feet long and capable of and provided with the means of deflection for 500 feet from the axis of the channel.

"The boat may be provided with any other movement in operation, provided it does not interfere with the before-described movement and the advantages justify the additional cost. The engines shall be triple expansion, of marine type, and directly connected with the main pumps.

"The weight of each pump shall be given, as well as the weight of each engine, whether used for the main or supplementary pump or warping drums. A list of duplicate parts shall be given which it is proposed to furnish.

"Other information concerning all parts and the proposed power, speed, steam, and fuel consumption is requested, as well as a description of any special advantages that may belong to the design or construction.

"The capacity of the dredge, together with the strength and workmanship of all parts of the plant, will be given great weight in the selection of a design, and weakness of construction will be considered a fatal defect.

"It is not desired that the dredge shall be provided with the means of self-propulsion. Quarters for the crew are not desired on the dredge.

"Pile drivers, quarter boats, and tugs or tenders are not to be furnished. All piles and lines are to be furnished. The operating expenses for a sixty days' test are to be paid for by the Government.

"Before the dredge and dredging plant are accepted and paid for by the Government they shall be subjected to the following tests:

"First. A test for determining the capacity of the pumps to lift and discharge material. This test shall be made by placing the dredge at work at some point on the river fixed by the United States engineer where an ordinary river sand may be obtained at the average depth of cutting. They shall discharge through 1,000 feet of pipe, each, with the pumps running at their average speed and without applying a forced draft to the boilers, into a barge fitted up for the purpose in such a way as to determine separately the respective amounts of sand and water discharged per hour. If the quantity of sand delivered is less than 1,600 cubic yards per hour, a deduction shall be made from the contract price which shall be proportional to this deficiency. If the quantity of sand delivered is greater than 1,600 cubic yards an hour, a premium shall be paid for the dredge directly proportional to this excess, not, however, to exceed 50 per cent of the contract price. These tests shall be carried out at the expense of the United States Government.

"Partial payments may be made, but 25 per cent of the cost will be retained till the final acceptance of the dredge and apparatus."

At a meeting of the committee on dredging, held at St. Louis Mo., December 10, 1894, the three companies mentioned submitted plans, specifications, and bids as required, and after a careful examination of each the proposition of the American Hydraulic Dredging Company, of Chicago, Ill., of which Mr. Lindon W. Bates is president, was accepted. The Commission required the contract to be made by and the building done under the supervision of this office. A contract was entered into with Mr. Lindon W. Bates January 25, 1895, and finally approved by the Chief of Engineers, U. S. A., February 23, 1895. The amount to be paid for the dredging plant, including a number of extra parts, is $172,775.

The following is a general description of the plant to be furnished:

Hull to be of steel, 172 feet long, 40 feet beam, and 7½ feet depth of hold; to have a water-tight deck laid 2 feet above the bottom plating, this water bottom to be divided into ten water-tight compartments, to which are to be added five other water-tight compartments at the ends. A cabin of pine, one story high, 138 feet long by 32 feet wide, will cover the machinery and boilers. The dredging machinery to consist of two centrifugal pumps, with runners 7 feet in diameter and suction and discharge inlets each 33 inches in diameter. Each pump will have three suction pipes, each 20 inches in diameter, the three joined to work on one bank of ladders, turning on a shaft across the bow of the boat, the outer end to be raised and lowered by wire cables, admitting of dredging to a depth of 20 feet, the movable pipes to connect with the fixed pipes on boat through a telescopic joint under the water. Revolving cutters to be placed at the ends of the suction pipes.

Connected to each pump will be 1,000 linear feet of discharge pipe 33 inches in diameter, supported by steel pontoons. Pipes to be in lengths of 50 and 100 feet, joined with rubber hose connections. Each pump will be driven by a direct connected, triple-expansion engine, with cylinders 20½, 33, 38 inches, and 38 by 24 inch stroke.

Steam will be supplied by four Heine water tube boilers of about 375 horsepower each.

A six-drum hoisting engine, with cylinders 14½ by 15 inches, will be located on the bow to control the forward movement of the dredge and handle the suction pipes. This will be done by wire ropes leading to anchor piles, etc.

Two compound engines, with cylinders 14½ inches and 29 by 18 inch stroke, will operate the cutters.

The boat will be supplied with an electric-light plant, blacksmith outfit, tools, etc.

The construction of this plant is now well under way. The pumps, engines, and various other machinery are being built at Baltimore, Md.; the hull is being built at Pittsburg, Pa. The Heine Boiler Company, of St. Louis, Mo., are building the boilers, and the floating pipes and pontoons are under construction at Springfield, Ill. It is expected that the various parts will be delivered at Cairo, Ill., and there assembled by the contractor in time to accomplish some work during the next low-water season.

Respectfully submitted.

GRAHAM D. FITCH,
Captain, Corps of Engineers.

Lieut. Col. G. L. GILLESPIE,
President Mississippi River Commission.

Sounding shoal bars—Cairo to White River, September 3–8, 1894.

Location.	Distance from Cairo.	Depth.	Remarks.
	Miles.	*Feet.*	
Filmore City	3	13	Sept. 3, Cairo gauge, 5¼.
Island No. 1 to Prichards Point	6	11	
Head of Puntney Bend	10½	10	
Head of Lucas Bend	15½	19	
Head of Columbus Bend	19¾	16	Belmont gauge, 3¼.
Point below Columbus	23	14	
Muscovalley	26½	15	
Foot of Wolf Island	29	11	
Medleys	30	7	
Parkers to Hickman Bend	34½	21	
Lesters to Phillips Bar Light	55½	10	
Phillips Bar to Slough Landing	39½	9	
Bessie to Island No. 10	64	18	
Laforge to Kentucky Point	68	14	
Kentucky Point to Morrisons Light	69	12½	Sept. 4, New Madrid gauge, 4.
New Madrid to Watsons	74	12	
State line	77	9	Above the wrecks of Guiding Star.
Do	77½	8	Below the wrecks of Guiding Star.
State line to Point Pleasant	79	8½	
Opposite Point Pleasant	79½	12	
Phillips Landing to Lazells	82	8	
Lazells to Silvertop	84	9	
Below Tiptonville	86	12½	
Cherokee	89	6	
Little Cypress Bend	93½	12	
Bend Island No. 14 to Hathaway	101½	12	
Hathaway to head of Prairie Bend	104	8½	
Foot of Prairie Bend	113	14	
Prairie Bend to Linwood	115	20	
Booth Point to Island No. 18	121½	14	
Opposite Cottonwood Point	123 7/10	18	Cottonwood Point gauge, 2.
Mitchells Light to Pemiscot Bayou	125	6	
Midway to Island No. 21	128 7/10	12	
Island No. 21 to Hickman, Ark	131	11	
Ruckers Point to Buckners	139	15	River Styx.
Head of Bend Island No. 25	145	13	Sept. 5.
Island No. 26 to O'Donnels	149	10½	
Gold Dust to foot of Ashport Bar	157	10	
Fletchers to Elmot Bar	158	6	
Elmot Bar to light above Elmot Landing	159¾	16	
Foot of Island No. 30	163¾	6½	
Plum Point to Bullerton	165½	7	
Pettys Light to Yankee Bar	168½	8	
Yankee Bar to Craighead Point	170½	9	
Fulton to Island No. 34	178	13	Fulton gauge, 4½.
Along Island No. 34	180¾	10	
Pecan Point to Cedar Point	196	14½	
Cedar Point to Deans Island	197	23	
Deans Island to Densfords Light	199½	12½	Sept. 6.
Thomas Light to Corona	203	18	
Centennial Cut-off to Fogleman Chute	207	12½	
Head of chute of Island No. 40	213	9	
In chute of Island No. 40	214	7½	
Head of Island No. 40	213	3	In main river; could not get out.
Paddy Hen to Mound City	226¾	7½	
Tennessee Chute	234	7½	Memphis gauge, 1½.
Nonconnah to foot of Presidents Island	239	10½	Sept. 7.
Reeves to Horn Lake	243¾	6	
Cow Island to Scanlans	247	20	
Scanlans to Graves Bayou	249½	6	
Cat Island to Norfolk	254	8	
Star Landing to Harkleroads	259	11	
Commerce to Blues Point	269	14	
Blues Point to below Peters Landing Light	281	10	Mhoon Landing gauge, 3.
Walnut Landing to opposite Rosa Lee Landing	283¾	13	
Fox Island to Hardins Point	284¾	14	
Harberts to Shoo Fly Light	293	13	
Foot of St. Francis Bend	302	12	Helena gauge, 1½.
Head of Montezuma Bend	312	11	Sept. 8.
Friars Point to Westover	319	11	
Head of Island No. 62	330	13	
Island No. 63 to Modoc	334½	9	
Head of Island No. 66	350	17	Sunflower gauge, 3.
Island No. 69 to Australia	369½	13	
Island No. 71 to Concordia	378	17½	
Henrico to Scrub Grass	384	11	
Head of Victoria Bend	391½	18	

APPENDIX 5 A.

REPORT OF ASSISTANT ENGINEER WILLIAM GERIG ON IMPROVEMENT OF HARBOR AT HICKMAN, KY.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., March 1, 1895.

CAPTAIN: I have the honor to submit my report on improving Hickman, Ky., harbor during 1894:

The project called for—

(1) Grading the projecting clay points along the bank and paving with a layer of riprap 1 foot thick to provide a low-water landing.

(2) To make the landing permanent by extending the existing revetment to the lower end of the clay ledge with fascine mattresses 250 feet wide.

(3) The landing itself should be revetted from the water line to the top of the bank by a layer of riprap 1 foot thick.

(4) To stop, if possible, the settling of the bank along Front street. The revetment along the proposed low-water landing should be extended about 200 feet farther downstream, so as to cover the depression through which drainage takes place.

Description.—The foot of the mattress placed in 1889 was found to be at Station 76+50, and in order to give a good lap the upper edge of the present mattress was placed at Station 76 and extended to Station 82+20, so as to cover the depression caused by drainage.

The depth of the water at Station 76 was 85 feet. The bottom of the river sloped gradually upward to Station 81, where the depth was 60 feet, and at Station 82 the depth was only 3 feet.

The mattress was made 630 feet long so that it could adjust itself to the shape of the river bed and still extend to the top of the ledge of rock at Station 82.

The underlying brush of the bank revetment of 1889 was almost entirely decayed, caused by insufficient ballast, exposing it to the air and moisture. This was repaired by paving with a layer of riprap 10 inches in thickness.

The clay points were graded and the entire bank from Station 76 to Station 84 was paved, from the low-water line to the top of the bank, with a layer of riprap 12 inches in thickness.

Construction.—The first tow of plant for Hickman, by steamer *Minnetonka*, consisting of quarter boats, mat and mooring barges, pile driver, and empty barges—in all fourteen pieces—left the fleet at Memphis, Tenn., on September 13, and arrived at Hickman, September 16. Work was begun September 17 clearing bank, hand grading, and removing the stone from around the clay points where it had been placed by local authorities to prevent erosion. This stone was used in paving the bank along the water line near Station 80 and Station 81.

The work of constructing the mattress was begun September 26, immediately after the arrival of the steamer *Joy Patton* with the fascine barges.

The season was good and little time was lost on account of rain.

The river was very low, the gauge at Cairo, Ill., registering 5 feet, and navigation above Cairo was both troublesome and uncertain.

Labor.—The supply at this place was not sufficient to carry on this work to an advantage, even after having obtained about 100 negroes from Memphis, Tenn. These had been employed during previous years at Hopefield Bend, Arkansas, and were experienced, which was quite an advantage in the construction of the fascine mattress.

Whites subsisted by the Government were employed in all the responsible positions, and most of the common laborers were negroes, and self-subsisting. The price paid was the same as last year—$25 per month and subsistence, the self-subsisting labor receiving $1.15 and $1 per day of eight hours for the first month and $1.25 per day thereafter, if full time was made. Only a few white men were subsisted on the fleet, sailor men principally, and these were required to be on duty at any time during an emergency or coaling steamboats, etc. The maximum number of men employed was 256, on October 1.

Materials.—Brush and poles were obtained by contract at $1.07 per cord, for the former and $1.50 per cord for the latter, delivered on United States barges at the contractors' camp, and the source of supply was from 65 to 75 miles above the work.

Stone was obtained by contract at 52 cents per cubic yard for riprap and 47 cents per cubic yard for spalls, delivered on Government barges at the quarries, at Apple Creek, Mo., which was about 105 miles above the work. About 1,850 cubic yards was bought, delivered on contractors' barges at the work, for $1.25 per cubic yard.

The cost of towing the brush and poles was 44 cents per cord and the stone 66 cents per cubic yard. This was excessive, on account of low water, there being only from 3 to 4 feet on some of the crossings above Cairo, causing the loss of much time, since steamboats could not run after dark and the barges could not be more than half

loaded. As there were only fourteen barges available for this work, in order to keep them moving as fast as they were loaded and unloaded, and to make the deliveries promptly, it was found necessary to employ three light-draft steamboats; hence the *Joy Patton* and *Margaret* were chartered to assist the steamer *Graham*. Even then much time was lost waiting for stone and brush.

Fascine mattress.—The method of holding the mooring barges by means of cables fastened to the shore, and also the method of constructing the fascine mattress, was the same as at Hopefield Bend, Arkansas, during 1893, and was explained in detail in my report on that work.

The progress made was good, with the amount of materials and class of labor at hand.

Mattress construction was begun September 26 and completed October 5, when the mattress was sunk. The maximum linear feet of mattress made per day was 130, on October 1, and 192 men were employed.

The mat was 630 by 250 feet=1,575 squares (100 square feet).

The cost per square was $7.073.

Grading.—The bank was graded to a slope of about 1 on 4, and this slope was carried to the top of bank. Hydraulic grading was confined to a point between Station 78 and Station 80, which was very hard to grade, as the bank had settled here in former years, and was filled up with wood, brick, and stone—some pieces of stone around this point weighing as much as 2 tons. These were broken and used in paving the bank. Probably 400 cubic yards of stone was obtained here. The material was a clay foundation, and the expense of grading was increased, since it was found necessary to keep an extra force with the grader to move the brick, stone, timber, etc., as it was exposed, so that grading could proceed. Hydraulic grading was commenced October 6 and finished October 14. The grader used was No 40, which has been in use several years, and which had just been overhauled and repaired.

Work done, 135 linear feet=7,498 cubic yards.

Cost per cubic yard, $0.098+.

Before laying the paving the bank was neatly dressed by hand.

Connecting mattresses.—Two small connecting mattresses were placed where the river mattress did not come up to the shore line. They were also of the fascine type, the fascines being parallel to the river bank. This mattress overlapped the river mattress about 10 feet. Total connecting mattress made was 140 squares.

Cost per square was $8.362.

Paving bank.—This work was begun September 17 along the city front, with stone taken from the point at Station 79 and was completed on November 3. On November 10 the mat plant was moved to New Madrid, Mo., and a party was left here to finish the work. Paving began at or near the low-water line, and extended within 3 to 10 feet from the top of the bank.

The paving from Station 77 to Station 84, being new work, was 1 foot in thickness, while over the bank work of 1889 it was placed only 10 inches thick. Stone used in paving was of two kinds, riprap, pieces weighing from 5 to 35 pounds, and spalls, pieces weighing less than 5 pounds; the latter were placed on the graded bank first, to a thickness of from 3½ to 4½ inches, and then the former was placed, so as to lay closely together, to a thickness of from 7½ to 8½ inches.

The citizens decided to widen Front street from Station 80 to 84, and here the paving was only brought up to where the slope of the street was to come. After this work was done, and when the river had risen to 30 feet at Cairo, Ill., the paving was completed to the top of the bank by Assistant Engineer LeVasseur in January, 1895.

Over the bank work of 1889 the paving extended up to within 10 feet of the top of the bank.

Total bank paved during 1894–95 was 208,242 square feet.

The cost per square foot was $0.090+.

Statement of expenditures.

Total material and labor expended, as per abstract, during 1894.....	$29,651.33
Total material and labor expended by Assistant LeVasseur.....	3,465.12
Total material and labor expended in preparation and repairs to plant and steamer *Minnetonka* (which was sunk while in this service).....	7,915.10
Total expended.....	41,031.55

Herewith is a statement of expenditures and also a map showing the location of the work.

Very respectfully, your obedient servant,

WM. GERIG, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Abstract of expenditures at Hickman, Ky., for 1894.

Items.	Superintendence.	Care of plant.	Repairs to plant.	Miscellaneous.	Towboats.		
					Graham.	Joy Patton.	Margaret.
Labor	$481.25	$281.27	$223.34	$146.97	$1,311.84	$78.17	.....
Subsistence:							
Service	7.85	20.68	6.60	15.70	108.00	17.33	.....
Supplies	46.81	71.04	22.68	53.92	159.51	13.10	$5.58
Coal	.....	14.00	.....	.....	746.40	91.25	220.01
Lumber	.....	.....	23.54	.....	.....	.....	.....
Spikes and nails	.....	.....	24.08	.....	.....	.....	.....
Hire of steamers	.....	.....	.....	.....	.....	480.00	1,527.50
Oils and engineers' supplies	.....	16.16	3.75	.....	18.40	9.76	.....
Miscellaneous	800.00	69.69	.....	.....	.50	.....	.....
Total	1,335.91	472.84	303.99	216.59	2,344.65	689.61	1,753.09

Items.	River mattress.	Connecting mattress.	Bank revetment.			Total.
			Hydraulic grading	Hand grading.	Paving.	
Labor	$2,142.71	$149.00	$609.50	$165.94	$2,616.65	$8,206.61
Subsistence:						
Service	94.43	4.11	2.74	5.36	11.95	294.75
Supplies	324.39	14.12	9.41	68.38	70.09	859.03
Brush	2,580.01	163.92	.....	.....	.....	2,743.93
Poles	211.95	.....	.....	.....	.....	211.95
Stone	1,178.73	255.34	.....	.....	6,296.26	7,730.33
Wire, annealed	120.60	2.40	.....	.....	.....	123.00
Wire strand	548.71	31.26	.....	.....	.....	579.97
Wire, silicon bronze	304.86	.....	.....	.....	.....	304.86
Clips	285.00	.....	.....	.....	.....	285.00
Staples	7.00	1.00	.....	.....	.....	8.00
Coal	.....	.....	28.00	.....	.....	1,099.66
Rope, manila	370.49	.....	.....	.....	.....	370.49
Lumber	.....	.....	.....	.....	.....	23.54
Spikes and nails	5.50	.....	.....	.....	.....	29.58
Cables	310.17	.....	.....	.....	.....	310.17
Hire of steamers	.....	.....	.....	.....	.....	2,007.50
Oils and engineers' supplies	.....	.....	4.00	.....	.....	52.07
Hire of barges	500.00	24.00	.....	.....	1,000.00	1,524.00
Ice	20.00	.....	.....	.....	42.00	62.00
Towing	840.17	.....	.....	.....	847.98	1,688.15
Chain	82.10	.....	.....	.....	.....	82.10
Miscellaneous	134.56	.....	3.20	.....	46.57	1,054.61
Total	10,061.38	645.15	656.94	239.68	10,931.50	29 651.33

Abstract of expenditures at Hickman, Ky., from January 16, 1895, to February 4, 1895.

Items.	Superintendence.	Labor.	Subsistence.	Material.	Towboats.	Repairs.	Oil and supplies.	Amount of work done.	Total cost.
Grading	$20.00	$80.63	$50.00	.....	.....	.....	.....	150 cubic yards	$150.63
Paving	320.00	487.00	84.43	$1,839.90	$579.46	$2.20	$1.50	24,000 square feet	3,314.49
Total	340.00	567.63	134.43	1,839.90	579.46	2.20	1.50	.....	3,465.12

APPENDIX 5 B.

REPORT OF ASSISTANT ENGINEER WILLIAM GERIG ON IMPROVEMENT OF HARBOR AT NEW MADRID, MO.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., March 5, 1895.

CAPTAIN: I have the honor to submit my report on improving New Madrid (Mo.) Harbor during the fall of 1895:

The work covered by the project embraced the continuation of the existing revetment as far downstream as funds would permit, i. e., the construction of a fascine mattress 250 feet wide and the paving of the bank to about the 30-foot stage.

Construction.—Work began immediately after the arrival of the mattress plant from Hickman, Ky., on October 10, 1894. The season was good, the river remaining nearly stationary during the prosecution of the work. The first time lost by rain was October 12, and the total time lost was one and one-half days.

Labor.—The labor was not as abundant as at Hickman, but was better as a class. The rates of pay were the same as at Hickman. The maximum force employed was 207 on October 16.

Materials.—Brush and poles were obtained by contract, at $1.07 per cord for the former and $1.50 per cord for the latter, and the source of supply was from 70 to 90 miles above the work. The deliveries were prompt considering the extreme low water and many shoal crossings. The cost of towing brush and poles was 42 cents per cord.

Stone was obtained by contract from Apple Creek, Mo., at $1.60 per cubic yard for riprap and $1.30 per cubic yard for spalls, delivered at the work by the contractor. Some time was lost waiting for stone, but the contractor made the deliveries as fast as called for by the contract.

Fascine mattresses.—The method of constructing the fascine mattress, was the same as at Hopefield Bend, Arkansas, during 1893, and was fully explained in my report on that work. The progress made during construction was better than at Hickman. The maximum number of linear feet of mattress made per day was 130, and only 181 men were employed. Mattress construction was begun October 11 and completed October 23, when the mattress was sunk. One mattress, 250 by 725 feet, was sunk, the upper edge being at a point 90 feet below Station 8 and extending to a point 115 feet below Station 7 of the survey of 1893, overlapping the existing mattress about 25 feet.

One mattress was 725 by 250 feet=1,812.5 squares. Its cost in detail was:

Labor and subsistence	$2,279.15
2,960.33 cords brush	3,167.54
124.1 cords poles	202.65
1,382.02 cubic yards stone	2,211.25
6,000 pounds wire, No. 12 steel	92.39
1,240 pounds wire, No. 9 steel	17.85
2,000 pounds wire, silicon bronze	320.73
20,167 pounds wire, strand	631.87
2,125 Crosby clips	268.75
400 pounds staples	2.00
Manila rope	185.27
Piling	4.50
Wire cables (mooring)	131.59
Miscellaneous material	144.20
Superintendence	211.33
Care of plant	237.26
Repairs to plant	102.04
Towing brush	1,213.28
Miscellaneous expenses	55.50
Total	11,479.15

Cost per square of mat built, $6.333+.

Average quantities of material used in the construction of one square (100 square feet) of fascine mattress was:

Brush	cords	1.633
Poles	do	.068
Stone	cubic yard	.762
Wire, steel, No. 12	pounds	3.310
Wire, steel, No. 9	do	.684

Wire, silicon bronze	pounds..	1.103
Wire, strand	do....	11.127
Clips	number..	1.200
Staples	pound..	.220

Grading.—The bank had a good slope, about 1 on 3, and no hydraulic grading was necessary. Preparatory to paving the bank was neatly dressed by hand. The cost of hand grading was $537.02, or $0.767 per linear foot of bank paved.

Connecting mattress.—One narrow connecting mattress was placed where the river mattress did not come up to the water's edge. This mattress was also of the fascine type, the fascines being parallel to the river bank, and overlapped the river mattress about 10 feet.

Total squares of connecting mattress made were 88.

Its cost in detail was:

Labor and subsistence	$196.67
100 cords of brush	107.00
200 cubic yards of stone	320.00
500 pounds of wire, steel	7.60
Superintendence	21.13
Care of plant	23.72
Repairs to plant	10.20
Towing	100.00
Miscellaneous expenses	5.55
Total	791.87

Cost per square built, $8.998+.

The average quantity of stone used per square, 2.28 cubic yards.

The excessive cost was due to the large amount of stone placed on the mattress.

Paving.—This work was begun October 31 and was completed November 15. Paving began at or near the low-water stage and extended to the top of the strata of sand, or to about the 30-foot stage.

The average thickness of the paving was 12 inches—4 inches of spalls and 8 inches of riprap.

Length of bank paved was 700 feet, and the square feet of bank paved was 80,766, or 8,974 square yards.

Its cost in detail was:

Labor and subsistence	$1,251.92
2,743.34 cubic yards stone	4,004.90
Miscellaneous material	21.50
Hand grading	537.02
Superintendence	126.80
Care of plant	142.36
Repairs to plant	61.22
Miscellaneous expenses	33.30
Total	6,179.02

Cost per square foot, $0.076+; cost per square yard, $0.689+.

SUMMARY.

River mattress, 725 linear feet, 1,812.5 squares	$11,479.15
Connecting mattress, 88 squares	791.87
Paving, 700 linear feet, 80,766 squares	6,179.02
Expended preparing plant and for property	1,549.96
Total expended	20,000.00

Transmitted herewith is a tabulated statement of expenditures and also a map showing the location of the work.

Very respectfully, your obedient servant,

WM. GERIG, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Abstract of expenditures at New Madrid, Mo., for 1894.

Items.	Superintendence.	Care of plant.	Repairs to plant.	Miscellaneous.	Towboats.			River mattress.	
					Graham.	Joy Patton.	Margaret.	Amount.	Cost.
Labor	$260.42	$236.01	$92.50	$34.77	$57.33	$615.84			$2,072.40
Subsistence:									
Service	10.87	27.66	6.05	16.67	6.00	34.00			55.39
Stores	37.97	71.21	15.58	42.91	18.00	42.67	$12.40		151.36
Brush ....cords								2,960.32	3,167.54
Poles ....do								124.10	202.65
Stone...cubic yards								1,382.02	2,211.25
Wire, No. 12, pounds								6,000	92.39
Wire, No. 9....do								1,240	17.85
Wire, silicon bronze, pounds								2,000	320.73
Wire strand, ½ inch, pounds								11,886	390.85
Wire strand, ⅜ inch, pounds								6,973	184.78
Wire strand, ¼ inch, pounds								1,308	56.24
Clips ....number								2,125	268.75
Staples....pounds								400	12.00
Coal		55.00			79.12	38.75	54.46		
Rope, manila									185.27
Lumber			40.23						
Piling									4.50
Spikes and nails			18.25						5.50
Oils and engineer's supplies		13.46			10.43	5.78	3.25		
Hire of steamers						320.00			
Cables									131.59
Miscellaneous	50.00		.85		15.25				138.70
Total	359.26	403.34	173.46	94.35	186.13	1,057.04	70.11		9,669.74

Items.	Connecting mattress.		Bank revetment.			Total, 700 linear feet bank revetment.		Quantities per square of river mattress.
			Hand grading (cost).	Paving.				
	Amount.	Cost.		Amount.	Cost.	Amount.	Cost.	
Labor		$191.81	$507.00		$1,181.48		$5,249.56	
Subsistence:								
Service		1.36	8.40		9.68		176.08	
Stores		3.50	21.62		60.76		477.98	
Brush ....cords	100	107.00				3,060.32	3,274.54	1.633
Poles ....do						124.10	202.65	.068
Stone ..cubic yards	200	320.00		2,743.24	4,004.90	4,325.26	6,536.15	.762
Wire, No. 12, pounds	380	5.86				6,380	98.25	3.310
Wire, No. 9....do	120	1.74				1,360	19.59	.684
Wire, silicon bronze, pounds						2,000	320.73	1.103
Wire strand, ½ inch, pounds						11,886	390.85	11.127
Wire strand, ⅜ inch, pounds						6,973	184.78	
Wire strand, ¼ inch, pounds						1,308	56.24	
Clips....number						2,125	268.75	1.200
Staples....pounds						400	12.00	.220
Coal							227.33	
Rope, manila							185.27	
Lumber							40.23	
Piling							4.50	
Spikes and nails							23.75	
Oils and engineer's supplies							32.92	
Hire of steamers							320.00	
Cables							131.59	
Miscellaneous					21.50		226.30	
Total		631.27	537.02		5,278.32		18,460.04	

APPENDIX 5 C.

REPORT OF ASSISTANT ENGINEER AUG. J. NOLTY ON OPERATIONS OF CONSTRUCTION PARTIES UNDER HIS CHARGE.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., March, 1895.

CAPTAIN: I have the honor to submit my annual report of the operations of the construction parties under my charge during the season of 1894–95.

The period covered by this report begins with September 16, 1894, upon which day the first tow of plant was taken to Ashport Bend by the steamer *Titan*. The second tow did not leave until the 25th of the same month, as the *Titan* was required to assist in raising the sunken steamer *Minnetonka*, and the chartered towboat *Jay Gould* did not arrive at the fleet until the 24th. Plant was moved up to Ashport Bend and Bullerton Towhead as fast as towboats became available.

Ashport Bend.—The project for this place was the completion of the revetment of this long bend and the repair of a fault, which, originating in the 1892–93 work, had by successive caving during high water worked downstream until it included about 125 feet of the 1893–94 work.

The new work of the season begins at 153 + 40, overlapping the previous season's work by 25 feet, and ends at Station 166 + 40. Two river mats were constructed, one 1,085 feet long and the other 294 feet. The width of each is 260 feet. The construction of two instead of one was rendered necessary by the shape of the shore line. Had the mat been made in one continuous length it would, in order to clear the point below, have left a wide uncovered space between the inshore edge of the mat and the shore line, subsequently to be covered with connecting mats. Hence the first mat was continued down as far as it was possible to closely follow the shore line and then sunk. The mat plant was then reversed and the work finished by working from just above the salient upstream until a lap of 25 feet over the foot of the first mat was obtained. This method enabled us to closely follow the shore line, and eliminated all but one small connecting mat.

Mat No. 15, the long one, was begun on the 2d of October and sunk on the 22d.

Mat No. 15a, the short one, was begun on the 22d of October and sunk on the 27th.

The apparently slow progress in the construction of these two mats was due entirely to the scant supply of brush, which caused frequent stoppages of the work or compelled us to work with a largely reduced force.

Grading.—As soon as mat No. 15 was sunk grading of the bank was begun. The bank was graded to a slope of 3 to 1 from the zero line up to the two-thirds stage, the balance of the bank being left standing with a vertical face.

This work was done with hydraulic graders Nos. 2 and 4.

Paving.—As soon as the grading had advanced sufficiently far to not interfere with the pavers, the riprap was carefully laid upon a 4-inch spall foundation spread in advance on the slope. The paving was carried up to the 17-foot stage.

On November 1 the mat plant, together with the bulk of the working force, was transferred to Bullerton Towhead, a small party in charge of a foreman being left to complete the paving, grading, and repairs to old work. In addition to the above work the party had also to load stone from the storage piles at Ashport and Fletchers bends for their own consumption and for that of the Bullerton party.

All work was finally completed December 19, when the force was paid off. All mattress work made here was of the fascine type.

Bullerton Towhead.—Work was begun here on the evening of September 27, upon which day a small party begun clearing the bank for a distance of 1 mile of standing timber, brush, and drift for 50 feet back from the edge, and doing other work preliminary to beginning mat construction. By October 7 enough plant was up here to enable us to begin mattress work, and on the 9th the plant was swung into position for the first mat. This is designated mat No. 5, four having been constructed here the previous season, and the successive mats have been numbered in the order of their construction and not according to their geographical position. Thus No. 5 lies between Nos. 6 and 9.

The head of No. 5 was placed 3,000 feet below the foot of No. 4. Mat No. 5, which is 1,016 feet long by 260 feet wide, was sunk October 28. The slow progress in the construction of this mat was caused by frequent failures in the brush supply. Mat No. 6 was begun October 30 and sunk November 10. It is 986 feet long and 260 feet wide and overlaps the head of No. 5 25 feet.

November 1 the mat plant from Ashport Bend was received here and the construction of mat No. 7 was begun on the 3d. The head of this mat was placed about 950 feet below the foot of No. 5, and its lower end marked the termination of the revetment. The length of No. 7 is 1,354 feet and its width 260 feet. Begun November 3, it was sunk on the 17th of the same month.

Mat No. 8, begun November 13, was sunk on the 24th, after attaining a lengtl 1,015 feet. Its width is 260 feet and its head overlaps the preceding season's worl feet, and its foot covers the head of No. 6 an equal distance. Mat No. 9 was be November 19 and sunk November 29. Its length is 978 feet, with a width of 260 f It covers the space between mats Nos. 5 and 7, each of which it overlaps 25 f This was the last of the river mats required here.

Connecting mats.—Of these there were required 14 to bridge the spaces betw the shore line and the inshore edge of the river mats in some of the deep scallc where it was impracticable to fit in closely the river mats. The 14 connecting m aggregated 981 squares, and each one overlapped the main mat 8 to 10 feet. Tl inshore edges rested on the low-water line. They varied in length from 260 tc feet and in width from 64 to 30 feet.

All mattresses, river and connecting, are of the fascine type. All those built pi to 1888 were of the woven type and from 100 to 150 feet wide. Those built sut quently were from 200 to 300 feet wide, and after 1892 the fascine mat was adop as the standard. While this latter type is much more expensive, by reason of larger quantity of material entering into its construction, the progress in build is much faster. With the woven type 100 linear feet was a good day's work, wl of the fascine mat 170 feet has been frequently made, and a result of 180 feet h under favorable conditions, been attained. One hundred and fifty feet of fasc mat may be considered an average day's work. It goes without saying, that rapid of construction is, owing to the relative shortness of the low-water season, of mu more importance than cost. But the great advantages of the modern type of n over the old style are its density, which prevents undermining; its flexibility, wh allows it to accommodate itself without rupture to the inequalities of bottom, a to quickly follow any cutting away under its outer edge with the result of fina checking this undermining, and its greater strength, which makes it much l liable to rupture while sinking.

Grading.—The work of grading the bank to a slope of 3 to 1 from the zero line to the 20 foot stage line was begun October 30 with hydraulic grader No. 2, supp mented on the 16th of the following month by grader No. 4, which had that d finished work at Ashport Bend. The progress of this work was slow and diffic owing to the bank being encumbered with remnants of the old shore work of bru and stone, which had to be first washed clean of the accumulated sediment on t and then broken up and removed before the grading could proceed. This old wc was in many places silted up to a depth of 3 feet, and most of the brush havi sprouted after being laid down in 1883–84, had finally formed a heavy growth willows with roots penetrating deep down. Down near the foot of the towhe where most of the old work had caved off, the bank was heavily timbered, and ma large stumps had to be removed. In order to expedite this work one pile driver c taining a duplex Worthington pumping plant was added to the grading plant, a the two large graders were each supplied with one No. 3 "Wells light," by the of which they were enabled to work twelve instead of eight hours. Grading v completed December 20, after which the machines were laid up. The slopes w graded up to the 20-foot stage, the remaining part of the bank being left standin

Paving.—This work was started as soon as the grading had advanced sufficien so as not to interfere with the men placing the riprap. A 4-inch layer of qua spalls was first spread and the stone laid upon this. Up to the middle of Dec ber this work proceeded without interruption, but after that date, the storage pi having been exhausted, the work could only proceed as fast as stone direct from quarries was received, and as the stage of water in the upper rivers was v low at that time much trouble and delay was encountered in bringing down to For the same reason barges could only be lightly laden. In addition to low wa ice in the upper rivers toward the end of December and early in January increa the difficulties of towage.

The working force was gradually reduced, a sufficient number of men to han the stone as fast as received being retained. January 11, nearly the entire rema ing force was paid off, leaving only a small skeleton organization which could rapidly filled up as soon as the stone yet to come had arrived.

The work was finally completed January 30 and on the following day the pl still remaining at Bullerton was towed to the harbor at Memphis.

Four hundred and eighty cubic yards of stone not required for the work was sto on the bank for future use.

REPAIRS TO AND PRESERVATION OF EXISTING WORKS.

Ashport Bend.—Included in the project for the season's work at this place was repair of a fault, which, originating in the 1892 work, extended downstream gradual caving until about 125 feet of the 1893 work was involved.

A preliminary examination made here gave evidence that the river mats were un jured, but simply lowered down by undermining from the inshore edge, and that

damage started by a rupture of the revetment along the low-water line, from whence it extended backward and downward. As soon as the last river mat had been finished the mat plant was moved to this fault and the repairs begun. These consisted in the construction of two floor mats, made to fit the pocket nicely and to overlap the river mats and each other. After these were sunk the foot of the bank was graded to a slope and covered with riprap up to the 6-foot stage. The two floor mats aggregated 442 squares. The work was begun October 27 and completed November 1.

The unusually low stage of river prevailing at the time operations were going on here uncovered parts of the 1892 and 1893 work that had heretofore been submerged, and these exposures showed that more stone was needed, hence it was decided to add more stone to these parts of the work. A total of 2,493 cubic yards of stone was expended on this work, of which 920 cubic yards was used in the "pocket" and the balance on the insufficiently ballasted work of 1892 and 1893.

Fletchers Bend.—A small section of the work near the low-water line required additional stone, and 85 cubic yards was thus expended.

Osceola Bar.—About 1,200 cubic yards of stone could have been advantageously expended along the 1884 and 1890 work, but the shortage in the stone supply prohibited this expenditure.

Bullerton Towhead.—About 150 feet of a long pile bulkhead filled with brush and stone, built in 1884 in front of a badly sloughing piece of bank, having been pushed out of perpendicular, and this being taken as evidence that this piece of bank was still sliding, the bulkhead was reenforced by buttressing it with stone dumped on the river face. One hundred and eighty-five cubic yards of stone was expended here.

Near the head of the 1893 work that part of the bank lying below the mid-stage line had settled somewhat, and this subsidence caused a separation of the paving, so that a bare face 2.5 feet high and about 400 feet long was exposed. This face was dressed off and repaved. Two hundred cubic yards of stone was thus expended.

Supply service, towage of brush.—As already mentioned, some delays involving loss of time were met with in the early stage of the season's work by reason of scant supply of brush. This, however, was not the fault of the contractors, but was mainly due to the disorganization of the towage service by the sinking, early in the season, of the *Minnetonka*.

Though this boat was at once raised and sent to the ways for repairs, it was of no further service to us during the season. The steamer *Jay Gould*, being at that time the only large towboat available, was at once chartered, and would have done rapid and economical service had it not been for the steady decline of the river, which compelled us after a month's trial to exchange this for a lighter draft boat. The *Charley McDonald* was then chartered. As soon as the *Titan* became available she also was put into the brush-towing service, and later on the *L. E. Patton*, a chartered boat, was added to the service. Henceforth the supply of brush was ample. In addition to supplying the large demand of the Ashport and the Bullerton construction parties, the Gold Dust Dam party had also to be supplied.

The maximum upstream towage was 120 miles and the maximum downstream 170. Two brush camps were required for furnishing the requisite amount of brush.

Deliveries of stone.—The contract entered into with Messrs. McTighe & Co. called for the delivery of 43,600 cubic yards of stone and spalls by December 1, 1894, two-thirds of this quantity to be delivered at the works by September 1 and the balance by December 1. As a matter of fact, however, the contractors failed most lamentably to furnish even an approximate amount by the dates specified. By September 1 they had only delivered 13,975 cubic yards, whereas by the terms of their contract 29,000 yards should have been at the works. Early in August, it being evident that there would be a large deficit in the stone supply, the steamer *Titan*, together with six United States barges, was loaned the contractors for one month, they to pay all expenses of running the boat and getting barges ready. Without this aid there would not have been sufficient stone to warrant a beginning of work on hand by the time operations were to begin.

The *Titan* was thus employed from August 11 to September 14, when she was withdrawn for the purpose of towing plant to the works. The steamer *Minnetonka* also brought down one tow for the contractors. Later on, the inability of the contractors to comply with the terms of their contract, having been fully demonstrated, the steamers *Margaret, Joy Patton*, and *L. E. Patton* were employed to tow stone purchased in open market under paragraph 12 of the contract specifications. Even with all the assistance given the contractors, there had been delivered by December 1 only 29,000 cubic yards.

The difficulties of towage were materially increased late in the season by the extremely low stage of water prevailing, but the main cause of the contractors' failure was their dilatoriness in beginning deliveries after the award of contract. This caused them to lose much of the best of the boating stage of river. Had the full quantity of stone been on hand by December 1 the work would have been completed by the end of December.

The quantity of stone actually delivered by McTighe & Co. was 23,117 cubic yards of riprap and 3,644 cubic yards spalls.

The following quantities of material were towed by United States steamers during the season, viz:

Brush, 30,143 cords; cost of towage per cord, $0.558.

Stone, 6,888 cubic yards; cost of towage per yard, $1.288.

It will be seen that the cost of towing stone is very high. Various causes operated to bring about this result, chief among which were the extremely low stage of river, which increased the difficulties of navigation and allowed us to put only light loads on the barges, and the slow loading of barges at the quarries. Boats that could have handled six loaded barges were compelled to either come down with two or three or else wait a long time for a full complement.

As an evidence of cheap towage under favorable conditions I will cite the work the *Titan* performed in the spring and summer of 1893, when this boat brought down nearly 24,000 cubic yards of stone at a cost per yard of $0.3088.

CONDITION OF WORKS AND RECOMMENDATIONS.

The condition of the revetment and closure works on Plum Point Reach was [illegible] the beginning of 1895 as follows:

Daniels Point.—This revetment was originally 5,300 feet long, and in 1892 it w[illegible]s contemplated to extend it farther upstream, but funds being required for the pr[illegible]o-tection at other places deemed of more importance, the extension was postpone[illegible]d. It has never been extended. All work above the zero line is badly wrecked, but [illegible] it is believed that all river mats are in place and uninjured. The bank should [illegible]be regraded from the low-water line up and covered with riprap on a 4-inch sp[illegible]all foundation.

Since 1892 the damage to the upper work has been going on steadily, and unl[illegible]ss this damage is soon checked it will result in rendering useless and inoperative t[illegible]he entire work. The maintenance of the present bank line I consider of vital imp[illegible]r-tance to the stability of both the Ashport and the Gold Dust crossings.

In addition to restoring the old work, the revetment should be extended upstre[illegible]m at least 5,000 feet. This would bring the work well above the Island No. 26 cr[illegible]s-ing, or to a point where there is no direct impingement of the current against [illegible]he bank. Above this proposed terminus the water is shoal and the bank is well p[illegible]o-tected against further erosion by the accretion to Island No. 25. River mats 260 f[illegible]et wide from the zero line out are recommended for this locality, with riprap runn[illegible]ng up to the two-thirds stage.

Daniels Point revetment was constructed in 1889, and repairs were undertake[illegible]n in 1892, but never completed.

Ashport Bend.—This work was last inspected early in the current year and w[illegible]as then found to be in excellent condition. No further work is considered necess[illegible]ry here under present conditions of river and bank. Both the upper (Ashport-Dani[illegible]ls Point) crossing and the lower (Gold Dust) crossing are in such good condition t[illegible]hat boats no longer take soundings there even at the lowest stage. Ashport revetm[illegible]ent was constructed in 1891, 1892, 1893, and 1894. Extensive repairs were made in 1[illegible]893 and slight ones in 1894. This revetment is 17,000 feet long. River mats are 200, 2[illegible]50, 260, and 300 feet wide.

Those built in 1891 and 1892 are of the woven type; all others are fascine mats.

Fletchers Bend.—The upper revetment, constructed in 1884, shows the effect of a[illegible]e. the high-water bank protection of those days consisted of a loosely woven br[illegible]sh mattress, over which stone was distributed. The slopes to which the bank w[illegible]as then graded were steeper than those now used, being 2¼ to 1. The brush foun[illegible]da-tion has long ago decayed, and as the stone was but scantily distributed over [illegible]it there are now numerous bare places exposed to the erosive action of the current [illegible]and waves. The damage is greatest at the foot of the artificial slope, or near the l[illegible]w-water line, where the decay of the brush allowed the stone to roll down the stee[illegible]per under-water slope, thus exposing long strips of bare bank. Owing to the shifting [illegible]of the low-water channel and the building of a bar in front there is very little str[illegible]in against this part of the bank. There is no present need of any repairs.

From the foot of the 1884 work, which is 2,800 feet long, for a distance of 7,[illegible]00 feet the work is in excellent condition. Below this lies the experimental "int[illegible]r-rupted" revetment, and here the caving back of the unprotected blocks has dama[illegible]ged the head and foot of the adjacent sections of revetments. Here the proposed s[illegible]b-merged stone spurs are to be built, but it will be found that even if these answer [illegible]he purpose of their construction the damaged extremities will have to be restored [illegible]in order to check further disintegration. Fletchers Bend revetments were construc[illegible]ed in 1884, 1888, 1889, and 1891, and repaired in 1893 and 1894. The total length of t[illegible]is work is, inclusive of the three unprotected blocks, which aggregate 1,200 feet [illegible]n length, 15,000 feet.

Gold Dust dikes.—This system shows no change except that due to age. It has accomplished its purpose, namely, the contraction of the excessive width of river. These dikes were constructed in 1882, 1883, and 1884, and while now practically destroyed, there is no present danger of injury to or destruction of the results obtained, especially as the old work has been reinforced by more modern works in the chutes below.

Dikes in Elmot and Island No. 30 chutes.—These dikes were constructed in 1889 and 1890, and show no change since last report. The chutes are closed at the 8-foot stage.

Plum Point.—Eight hundred feet of revetment was placed here in 1889 to relieve the bank from the attack of a strong current impinging against it. Since then by the downstream travel of the crossing the place of impingement has been shifted, and the revetment is almost entirely silted up. Late in 1894 the channel, which had heretofore run by Plum Point, changed its course toward Osceola Bar, and this has relieved the bank, which had up to then been caving extensively. Should the channel again resume its former course some work will undoubtedly have to be done here.

Osceola Bar.—What has been said of the Fletchers Bend revetment of 1884 applies to that constructed here in 1883-84, with the addition that the head of this work is badly disintegrated. The new work farther down is in first-class condition. I respectfully renew my recommendation, made in former reports, that the Osceola Bar revetment be extended upstream 3,000 feet, so as to cover the lower half of what formerly was designated "Upper Osceola Bar," but is now joined to Osceola Bar proper. The minimum distance across the bar to the chute is now less than 500 feet, and should this barrier be washed away the resultant effect would prove disastrous to the Plum Point crossings. A cut-off here would turn a large volume of water into the now closed Osceola Chute. The remnants of the old closure works in this and Bullerton Chute could offer but a slight resistance to any large increment of water, and the result would be the reopening of a chute closed only at a great expense and the consequent abstraction of a large volume of water from the lower crossings.

In addition to the revetment recommended the head of the 1884 work should be repaired and the small chute just above R 43 A be closed with a brush and stone sill founded on a small mattress.

The length of the 1884 work is 4,800 feet. Between this and the later work of 1890 and 1892 there is an unprotected interval of 4,500 feet. No work is considered necessary here, as but little erosion is going on there. The later work is 5,500 feet long and includes two brush and stone sills across two chutes.

Plum Point dikes.—This system was constructed in 1882–1884 for the purpose of contracting the excessive width of the river opposite Bullerton Towhead. They were repaired in 1885 and are yet in fairly good condition, except Dike No. 6, which is badly wrecked.

These dikes, six in number, were built from 1882–1884. Very little remains of them, but the chute is practically closed at midstage. These chutes were formerly the preferred low-water channels. As a reenforcement to the pile dikes in Bullerton Chute two brush and stone sills were in 1892 placed across the mouth of two chutes leading from the main river. These, together with the Osceola Bar and Bullerton Towhead revetments, form effective barriers against the efforts of the river to reopen Bullerton Chute. The only danger to be apprehended is from the caving away of Upper Osceola Bar.

Bullerton Towhead.—The original work was constructed in 1882–1884 and held until 1892, when several serious faults appeared. The damage increased rapidly, and in 1893–94 the entire revetment was renewed with heavier and stronger works.

Miscellaneous.—The following-named towboats and tugs were employed during the whole or part of the season, viz:

United States steamer *Titan*, 1 month and 25 days; *H. M. Graham*, 9 days; *Itasca*, entire season, as tender to works; chartered steamer *Jay Gould*, 1 month and 9 days; *Charley McDonald*, 1 month; *Margaret*, 1 month and 10 days; *L. E. Patton*, 1 month and 12 days; *Joy Patton*, 2 months and 14 days; tug *Thos. Heidel*, 1 month and 21 days, as tender to works. Four barges 100 by 25 feet were chartered for the entire season at $4 per day each.

The following is a summary of the work done:

Ashport Bend:

River mats constructed, 1,379 by 260 feet, equal to	squares..	3,585.5
Connecting mats constructed	do....	64
Floor mats constructed	do....	442
Paving	square yards..	7,150
Grading	cubic yards..	39,000
Stone loaded on barges	do....	4,146
Poles cut	cords..	18
Abutments driven	number..	2
Additional stone on old work	cubic yards..	1,573

Fletchers Bend:

Stone loaded on barges	cubic yards..	4,557
Additional stone on old work	do....	85

Bullerton Towhead:

River mat made, 5,349 by 260 feet, equal	squares..	13,907
Connecting mat made	do....	981
Grading	cubic yards..	116,332
Paving	square yards..	36,360
Stone loaded on barges	cubic yards..	718
Stone unloaded on bank	do....	480
Bank cleared	square yards..	28,000
Abutments driven	number....	5
Additional stone on old work	cubic yards..	385

Large scale work sheets, with the work done plotted thereon, and an annual abstract of expenditures, giving the total and the unit cost of the work, accompany this report.

Respectfully submitted.

AUG. J. NOLTY, *Assistant Engineer.*

Capt. G. D. FITCH,
Corps of Engineers, U. S. A..
(Through Mr. W. M. Rees, Assistant Engineer in charge.)

Abstract of expenditures at Ashport Bend, Plum Point Reach, season 1894-95.

Items.	Superintendence.	Care of plant.	Repairs to plant.	River mattress. Mat No. 15. Amount.	Mat No. 15. Cost.	Mat No. 15a. Amount.	Mat No. 15a. Cost.	Bank revetment. Grading (cost).	Paving. Amount.	Paving. Cost.	Total.
Labor	$203.26	$622.32	$236.02	.....	$2,759.49	.....	$413.67	$572.12	.....	$685.54	$5,492-
Subsistence	37.74	155.70	57.93	.....	1,142.80	.....	213.73	139.72	.....	232.90	1,980-
Brush ..cords	.....	.....	.....	4,298	4,598.86	923	987.61	.....	.....	.....	5,586-
Poles .....do	.....	.....	.....	33	49.50	.....	.....	.....	.....	.....	49-
Stone..cu. yds	.....	.....	.....	2,712	3,689.68	944	1,284.31	.....	2,041	2,776.78	7,750-
Wire, No. 9, lbs	.....	.....	.....	.....	.....	1,100	15.84	.....	.....	.....	15-
Wire, No. 12, lbs	.....	.....	.....	2,741	73.01	510	7.85	.....	.....	.....	80-
Wire, silicon bronze ..lbs	.....	.....	.....	3,147	472.05	.....	.....	.....	.....	.....	472-
Wire strand, ¼ inch.....lbs	.....	.....	.....	14,105	416.09	668	19.70	.....	.....	.....	435-
Wire strand, 7/16 inch.....lbs	.....	.....	.....	7,680	211.79	1,413	37.44	.....	.....	.....	249-
Wire strand, ½ inch.....lbs	.....	.....	.....	764	20.93	1,000	28.90	.....	.....	.....	49-
Clips, Crosby, ¼ inch.....No	.....	.....	.....	10	1.50	.....	.....	.....	.....	.....	1-
Clips, Crosby, 7/16 inch.....No	.....	.....	.....	2,527	315.87	.....	.....	.....	.....	.....	315
Clips, magnolia, ⅝ inch, number	.....	.....	.....	.....	.....	638	47.85	.....	.....	.....	47
Clips, bevel, number	.....	.....	.....	.....	.....	120	5.40	.....	.....	.....	5
Staples....lbs	.....	.....	.....	542	23.60	147	3.67	.....	.....	.....	27
Clamps, cable, number	.....	.....	.....	.....	.....	112	8.12	.....	.....	.....	8
Chain	.....	.....	.....	.....	12.41	.....	.....	.....	.....	.....	12
Rope, manila	.....	.....	.....	.....	119.67	.....	.....	.....	.....	.....	119
Rope, wire	.....	.....	.....	.....	144.43	.....	.....	.....	.....	.....	144
Coal	.....	38.50	.....	.....	.....	.....	.....	201.09	.....	.....	239
Handling stone	.....	.....	.....	.....	329.18	.....	114.58	.....	.....	247.73	691
Towing	.....	300.00	.....	.....	2,500.14	.....	645.50	200.00	.....	603.85	4,339
Oil and supplies	.....	29.67	.....	.....	.....	.....	.....	14.58	.....	.....	44
Miscellaneous	.....	32.39	10.20	.....	44.92	.....	10.27	83.09	.....	.....	180
Total	241.00	1,178.58	304.15	.....	17,015.92	.....	3,844.44	1,210.60	.....	4,546.80	28,341

Abstract of expenditures at Bullerton Towhead, Plum Point Reach, season 1894–95.

Items.	Superintendence.	Care of plant.	Repairs to plant.	River mattress. Mat No. 5. Amount.	Mat No. 5. Cost.	Mat No. 6. Amount.	Mat No. 6. Cost.	Mat No. 7. Amount.	Mat No. 7. Cost.
Labor	$1,001.79	$3,331.43	$38.43	.....	$2,269.40	.....	$2,146.88	.....	$2,406.32
Subsistence	95.40	1,024.45	11.75	.....	1,046.77	.....	757.78	.....	893.45
Brush ....cords	.....	.....	.....	3,750	4,012.50	3,675	3,932.25	3,981	4,259.67
Poles ....do	.....	.....	.....	30	45.00	60	90.00	66.4	99.60
Stone ....pounds	.....	.....	.....	2,540	3,455.67	1,913	2,502.63	2,220	3,020.81
Wire, No. 9 ....do	.....	.....	.....	2,900	41.76	748	10.77	1,512	21.77
Wire, No. 12 ....do	.....	.....	.....	4,194	64.59	3,159	48.65	3,779	58.19
Wire, silicon bronze ...do	.....	.....	.....	3,000	450.00	2,261	349.32	3,179	476.85
Wire strand, ¼ inch ....do	.....	.....	.....	13,208	389.64	10,075	291.17	16,770	495.55
Wire strand, ⅜ inch ...do	.....	.....	.....	7,476	198.11	5,043	133.64	7,162	189.79
Wire strand, ½ inch ....do	.....	.....	.....	3,021	84.27	2,309	66.79	3,122	85.54
Clips, Crosby, ¼ inch ....No	.....	.....	.....	159	23.85	68	10.20	108	16.20
Clips, Crosby, ⅜ inch ..do	.....	.....	.....	1,030	128.75	279	34.87	125	15.62
Clips, magnolia ¼ inch ..do	.....	.....	.....	.....	.....	.....	.....	127	11.43
Clips, magnolia, ⅜ inch .do	.....	.....	.....	1,811	135.82	362	27.15	1,817	136.27
Clips, bevel ....do	.....	.....	.....	.....	.....	966	43.47	581	26.14
Staples ....pounds	.....	.....	.....	490	22.30	265	16.01	750	26.92
Clamps, cable ....number	.....	.....	.....	18	1.30	291	22.49	85	6.16
Spikes ....pounds	.....	.....	.....	.....	.....	10	.28	10	.28
Chains	.....	.....	.....	.....	12.41	.....	12.42	.....	12.41
Rope, manila	.....	299.18	.....	.....	119.67	.....	119.67	.....	119.67
Rope, wire	.....	.....	.....	.....	144.45	.....	144.45	.....	144.45
Lumber	.....	94.40	.....	.....	.....	.....	.....	.....	.....
Coal	.....	428.50	.....	.....	.....	.....	.....	.....	.....
Handling stone	.....	.....	.....	.....	308.30	.....	232.19	.....	269.82
Towing	.....	600.00	.....	.....	2,302.80	.....	2,114.49	.....	2,327.28
Oil and supplies	.....	64.41	.....	.....	.....	.....	.....	.....	.....
Miscellaneous	.....	267.23	15.05	.....	42.75	.....	24.27	.....	27.07
Total	1,097.19	6,109.60	65.23	.....	15,300.20	.....	13,131.84	.....	15,147.26

Items.	River mattress. Mat No. 8. Amount.	Mat No. 8. Cost.	Mat No. 9. Amount.	Mat No. 9. Cost.	Connecting mattress. Amount.	Connecting mattress. Cost.	Bank revetment. Grading (cost).	Paving. Amount.	Paving. Cost.	Total.
Labor	.....	$2,253.96	.....	$1,767.37	.....	$1,628.70	$2,339.69	.....	$4,850.92	$24,034.98
Subsistence	.....	749.09	.....	639.78	.....	541.23	683.91	.....	2,040.91	8,484.52
Brush ....cords	3,764	4,027.48	3,659	3,915.13	1,274.7	1,391.83	.....	.....	.....	21,538.86
Poles ....do	60	90.00	60	90.00	.....	.....	.....	.....	.....	414.60
Stone ....pounds	1,830	2,489.72	1,830	2,489.72	696	946.91	.....	16,271	22,136.69	37,042.15
Wire, No. 9 ..do	606	8.72	2,115	30.46	77	1.00	.....	.....	.....	114.48
Wire, No. 12 .do	3,126	48.14	2,550	39.27	1,229	18.92	.....	.....	.....	277.76
Wire, silicon bronze ..pounds	2,393	358.95	2,221	333.15	690	104.85	.....	.....	.....	2,073.12
Wire strand, ¼ inch ....pounds	9,921	288.31	10,128	298.78	4,895	143.86	.....	.....	.....	1,907.31
Wire strand, ⅜ inch ....pounds	5,011	132.79	5,052	133.88	2,888	76.53	.....	.....	.....	864.74
Wire strand, ½ inch ....pounds	3,099	84.91	3,001	82.23	250	6.85	.....	.....	.....	410.59
Clips, Crosby, ¼ inch ...number	57	8.55	51	7.65	.....	.....	.....	.....	.....	66.45
Clips, Crosby, ⅜ inch ...number	232	29.02	380	47.50	427	53.37	.....	.....	.....	309.13
Clips, magnolia, ¼ inch ...number	616	56.23	190	18.05	217	20.04	.....	.....	.....	105.75
Clips, magnolia, ⅜ inch ...number	1,581	118.57	1,807	135.52	324	24.52	.....	.....	.....	577.65
Clips, bevel ..do	.....	.....	.....	.....	.....	.....	.....	.....	.....	69.61
Staples ...pounds	345	17.82	500	21.30	136	3.06	.....	.....	.....	107.41
Clamps, cable, number	251	18.20	.....	.....	5	.36	.....	.....	.....	48.51
Spikes ...pounds	10	.28	10	.28	.....	.....	.....	.....	.....	1.12
Chains	.....	12.43	.....	.....	.....	.....	.....	.....	.....	49.67
Rope, manila	.....	119.70	.....	.....	.....	.....	.....	.....	.....	777.89
Rope, wire	.....	144.45	.....	144.45	.....	.....	.....	.....	.....	722.25
Lumber	.....	.....	.....	.....	.....	.....	.....	.....	.....	94.40
Coal	.....	.....	.....	.....	.....	.....	422.90	.....	.....	851.40
Hose	.....	.....	.....	.....	.....	.....	571.12	.....	.....	571.12
Handling stone	.....	222.13	.....	222.13	.....	84.48	.....	.....	1,974.97	3,314.02
Towing	.....	2,133.78	.....	2,080.85	.....	741.77	500.00	.....	4,759.63	17,566.60
Oil and supplies	.....	.....	.....	.....	.....	.....	83.79	.....	.....	148.20
Miscellaneous	.....	24.30	.....	16.80	.....	.....	99.26	.....	67.25	583.98
Total	.....	13,437.53	.....	12,520.30	.....	5,788.08	4,700.67	.....	35,830.37	123,128.27

Abstract of expenditures, repairs to existing works, Plum Point Reach, season of 1894–95.

Items.	Connecting mat, Ashport.		Paving Ashport.		Paving, Fletchers Bend.		Paving, Bullerton.		Total.
	Amount.	Cost.	Amount.	Cost.	Amount.	Cost.	Amount.	Cost.	
Labor	.....	$373.66	.....	$900.61	.....	$20.67	.....	$69.35	$1,364.29
Subsistence	.....	170.73	.....	319.93	.....	6.90	.....	22.05	519.61
Brush.....cords..	711	760.77	.....	.....	.....	.....	.....	.....	760.77
Stone.....cubic yards..	920	1,251.66	1,573	2,140.07	85	115.64	385	523.79	4,031.16
Wire, No. 12.....pounds..	672	10.34	.....	.....	.....	.....	.....	.....	10.34
Wire, silicon bronze..do....	279	41.85	.....	.....	.....	.....	.....	.....	41.85
Wire strand ¼ inch..do....	1,746	51.50	.....	.....	.....	.....	.....	.....	51.50
Wire strand $\frac{7}{16}$ inch.do....	1,230	32.59	.....	.....	.....	.....	.....	.....	32.59
Clamps, bevel....number..	230	10.35	.....	.....	.....	.....	.....	.....	10.35
Staples.....pounds..	50	1.25	.....	.....	.....	.....	.....	.....	1.25
Clamps, cable....number..	56	4.06	.....	.....	.....	.....	.....	.....	4.06
Handling stone	.....	111.67	.....	190.93	.....	10.32	.....	46.83	359.75
Towing	.....	544.83	.....	588.32	.....	20.98	.....	95.04	1,249.17
Miscellaneous	.....	1.30	.....	.....	.....	.....	.....	.....	1.30
Total	.....	3,366.56	.....	4,139.86	.....	174.51	.....	757.06	8,437.99

APPENDIX 5 D.

REPORT OF ASSISTANT ENGINEER B. B. GORDON ON REPAIRS TO GOLD DUST DAM.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., February 6, 1895.

CAPTAIN: I have the honor to make the following report of work done under my charge, repairing Gold Dust Dam, during the season of 1894–95:

The work to be done was rebuilding the dam to a stage of 14 feet on the Amelia gauge, where it had settled below that line, and at the two breaks that occurred below during the high water of 1894; the construction of a submerged mat in the hole washed out below the break near the Tennessee shore (Stations 20–23), and the construction of two foot mats, 30 feet wide by 4 feet thick, on the up stream side, one at each break.

The two latter were built as one continuous structure with the dam proper, and no separate account of the cost was kept.

The floating plant, consisting of quarter boats *Mississippi* and No. 25, machine boat No. 1, and barge No. 59, loaded with fourteen dump cars for hauling stone, left Memphis October 27 at 5.15 p. m. (Machine boat No. 1 was returned to Memphis November 23.) No work was done in October, as my general foreman was employed by Assistant Engineer Nolty at Bullerton Bar, and did not report to me for duty until the afternoon of October 31.

Preliminary work.—Before active work on construction could be begun it was necessary to do a good deal of preliminary work—grading roadbed and building track for the transportation of stone, overhauling hoisting engines for handling cars across dam, and hauling brush from Gold Dust. On November 1 a force of 235 men was started grading roadbed, laying track, unloading material, etc., and on November 15 the track was ready for use as far as the second break in the dam (Station 20). The detailed cost of this work will be shown under the proper heading. The hoisting engines had also been thoroughly overhauled and a start made at hauling brush, and on November 16 work was begun on the construction of the submerged fascine mat in the hole washed out below break at Station 20, a detailed account of which will be given further on.

Brush.—There was used in the entire work 6,234 cords of brush and 80.3 cords of poles, of which 4,187.5 cords, including poles, was received at Gold Dust on barges and hauled to the site of work by hired teams, and 2,126.8 cords was received from sundry parties, delivered on site of work at $1.50 per cord.

The brush from Gold Dust was hauled from 2½ to 3 miles; 531 team days were made, at $2.50 per day, costing for teams $1,329.12. The labor employed was mostly self-subsisting, at $1.20 per day. The total cost for labor, unloading barges, and loading and unloading wagons, was $1,714.88; this includes subsistence and superintendence. Total cost of hauling 4,187.5 cords (including poles), $3,044, equal to $0.7270+ per cord.

Following is a statement of brush received and cost of same:

Contractor.	Number of cords.	Price.	Value.	Cost of hauling.	Cost of towing.	Cost of overhaul.	Total value.
Hunter & Frey	3,452.1	$1.07	$3,693.75	$2,509.52	$2,008.62	$243.28	$8,455.17
Jenkins & Luckett	655.1	1.00	655.10	476.15	381.20	.....	1,512.45
Mathews & Webb	1,160.1	1.50	1,740.15	.....	.....	.....	1,740.15
George Edrington	105.2	1.50	157.80	.....	.....	.....	157.80
H. L. Gillespie	168.6	1.50	252.90	.....	.....	.....	252.90
John A. Curlin	692.9	1.50	1,039.35	.....	.....	.....	1,039.35
Total	6,234	.....	7,539.05	2,885.67	2,389.82	243.28	1,357.82

Poles were received as follows:

From Hunter & Frey, 80.3 cords, at $1.50	$120.45
Towage	46.72
Hauling	58.33
Total	225.50
Total cost brush and poles	13,383.32

The stone for this work was delivered during the summer of 1894 on the bank on Elmot Bar. According to the measurement on barges, there was 6,410.34 cubic yards, costing $1.67 per yard on the bank, equal to $10,705.26. Of this amount, 1,949.30 cubic yards was transferred to Assistant Engineer Nolty, leaving 4,461.04 cubic yards, costing $7,449.93, expended on this work.

Transportation.—For the transportation of stone from the river to site of work a wooden tramway was built across Elmot Bar, 3,000 feet long, and a single track, with No. 12 steel rail, was laid along the dam for a distance of 2,300 feet. The cars, holding two yards each, were hauled from river to top of bank of chute by mule teams. Two mules were required to each car on the wooden track, which, with the driver, cost $2.50 per day. Across the dam the cars were handled by two hoisting engines and wire cables, one on each side of the chute. The engines were the same used last season, and were fully described in the report of Assistant Engineer Charles Le Vasseur. The cost of track construction was as follows:

Material, rails, lumber, spikes, etc	$643.58
Labor and subsistence	1,031.74
Total cost of track construction	1,675.32

The cost of transportation of stone was as follows:

Item.	Labor and subsistence.	Material.	Teams.	Total.
Repairs to hoisting engines	$291.85	$234.86	$23.39	$550.10
Track construction	1,031.74	643.58	.....	1,675.32
Track repairs (including car)	489.42	21.56	.....	510.98
Transportation, labor, and team	1,261.93	108.93	318.25	1,689.11
Total	3,074.94	1,008.93	341.64	4,425.51

Four thousand four hundred sixty-one and four one-hundredths cubic yards cost for transportation $4,425.51, or $0.992+ per cubic yard.

The total cost of stone for the work was:

4,461.04 cubic yards, delivered on bank, at $1.67	$7,449.93
Transportation as above	4,425.51
Total	11,875.44

or $2.662+ per cubic yard.

The cars used on this work were new, having been built by the Memphis Car and Foundry Company, but they were faulty in some of the details of construction, requiring some modification and repairs, causing a good deal of loss of time and consequent increased cost. Most of the more important changes have been made, and they will be in better shape for another season.

Fascine mat in hole below break.—During the high water of 1894 a break occurred in the dam near the Tennessee shore (Stations 20–23), and a hole of a maximum depth of 65 feet and a superficial area of some 150,000 square feet was washed out on the downstream side, undermining the lower slope of the dam to within 20 feet of the original center line. At the time work was begun this season the water in this hole stood at a stage of 4 feet on the Amelia gauge. In this hole it was proposed to build a fascine mat extending 200 feet below the dam, with fascines 2 feet thick for the first 100 feet,

and then reduced to 1 foot. It was, however, found impracticable to build them of less than 18 inches thickness, with sufficient buoyancy to carry the weight of the run.

My first instructions from Captain Roessler were to build this mat from the south side, with fascines normal to the axis of dam, and some 250 squares were built in this manner. I then had instructions to change the method and place the fascines parallel with the dam and normal to the flow of the water. This change was made, the new mat overlapping that first built up nearly to the water's edge, so that in sinking they would not become separated As no mat, barge, or other appliance could be gotten into this hole, the following method of construction was adopted: The first fascines were built on the bank, rolled off into the water, and hauled into place with the quarter-inch sewing strand, until enough had been put in to carry the weight of the run; then each fascine was built on the edge of the mat and rolled over and hauled tightly into place. No bottom strand was used, but on top five-sixteenths-inch strands were placed at intervals of 8 feet normal to the fascines and about 20 feet apart, parallel with the fascines, the whole being securely fastened together and to the quarter-inch sewing strand with clamps. The mat was securely lashed to the old dam, to prevent slipping outward in sinking, but the sides were left free to slide, so that the mat could adjust itself to the bottom. Poles were placed, forming cribs 8 by 20 feet, and the whole mat ballasted with stone, by wheelbarrows, as heavily as possible without sinking under the run, and by the time the ballasting had reached the dam the outer edge was about on the bottom. The balance of the stone was distributed from a flatboat, 12 by 30 feet, that I had to have built on the ground. The stone was as evenly distributed as possible, and the sinking was successfully done without any rupture or damage to the mat.

Soundings after the mat was sunk showed that in places it had settled into the mud as deep as the original bottom, and at two points seemed to have been held up at the outer edge, probably on a snag or logs. Generally it lay snugly on the bottom, as shown on sections herewith submitted.

An allowance of some 8 feet had been made on the side for the probable slide in adjusting itself to the bottom, but the actual slide was 14 feet on the north or Elmot Bar side of the hole; to cover this a connecting mat was built, or rather the original mat extended, the fascines being connected with the original, making one structure.

Work on this mat was begun November 16 and finished ready for the stone December 8. The progress was slow, due to the long distance the brush had to be carried by hand—from 300 to 500 feet.

The ballasting was finally completed January 5, 1895, the work having been delayed by the necessity of building a flatboat for distributing the stone, and then but a very small amount could be handled at a time.

The superficial area of the mat comprised 942.75 squares, and 2,350 cords brush, and 1,487 cubic yards stone was used in its construction, as appears in the following statement of detailed cost:

2,350 cords brush (contract prices)	$2,812.70
6 cords poles (contract prices)	9.00
1,487 cubic yards stone, delivered on bank	2,483.29
10,640 pounds wire strand (one-quarter and five-sixteenths inch)	298.60
6,084 pounds wire (Nos. 9 and 12)	90.99
1,544 clips	114.39
Team hire (hauling brush and stone)	657.03
Towage on brush	894.17
14,905 feet, B. M, lumber (used in track and flatboat)	181.98
Labor and subsistence (transportation of material)	1,824.75
Labor and subsistence (construction of mat)	2,664.91
Miscellaneous	308.28
Total	12,340.09

942.75 squares cost $12,340.09, or $13.08+ per square.

This cost is of course greatly in excess of the ordinary river mat of similar character, due to the increased cost of material and the want of the appliances generally used.

Repairs to dam.—The original dam of the season of 1893-94 was built to a stage of 16 feet on the Amelia gauge, with a crown of 16 feet in width. During the flood of 1894 two breaks occurred—one on Elmot Bar side (Station 0+50 to Station 2), and one near the Tennessee side (Stations 20-23), and the entire structure settled to and below the 14-foot stage, except from Stations 17 to 19+50, and from 27 to 29+60. The work to be done this season consisted in rebuilding the breaks and bringing the balance of the dam to a stage of 14 feet where it had settled below that contour. The foot mat on downstream side at break No. 1 was not damaged by the water of 1894, and the new work was built on the original line at that place.

At break No. 2 the downstream slope had been undermined and partially destroyed, which necessitated throwing the center line of the new work upstream from 0 to 25

feet from the original center line, as shown in plan and sections herewith submitted. A hole had been scoured out on the upstream side also, at this place, in which the water was from 4 to 10 feet deep. I had instructions to build a foot mat at each break, extending 30 feet outside the slope of the dam and of 4 feet thickness. I therefore adopted the following method of construction: A fascine mat similar to the one already described, and with fascines 18 inches thick, was built, as the bottom course of the dam, and extended 30 feet outside the slope for the foot mat. On this a course of brush 2½ feet thick was laid, forming the required thickness of 4 feet, for the foot mat. Five-sixteenths-inch wire strands were stretched tightly across this course, normal to the brush and 8 feet apart, and lashed tightly to the bottom mat with No. 9 wire, extending up through the brush.

These lashings were also 8 feet apart. The whole was then ballasted with stone to the verge of sinking, and the next course of brush, also 2½ feet thick, in the dam proper, was laid and fastened to the course below in the same manner, and this ballasted until the bottom rested on the ground.

The entire structure was built up in this way, in courses 2½ to 3 feet thick, and each course ballasted with stone about 8 inches thick. The slopes of 3 on 1 were carried up as the work was built. All the brush was laid parallel with the axis of the dam. The crown of the completed structure was 16 feet at the 14-foot stage. On the completed brush work poles were placed, forming cribs 8 feet square, and the whole ballasted with stone 1 foot thick.

From the above it will be seen that the foot mat forms one solid structure with the dam proper, and no separate account of the cost was kept of it.

The balance of the work bringing the dam to a stage of 14 feet was done in a similar manner; only one course of brush, however, being necessary in most places.

Above break No. 1 a pool of water was standing, about 3 feet deep, in which a foot mat was built, similar to the one already described, except that the bottom fascine mat was 42 feet wide to make it correspond to the original bank revetment on Elmot Bar. The top course of brush 2½ feet thick was 30 feet wide. This foot mat also formed one structure with the dam.

Work on repairs to dam was begun December 5, and the entire work completed January 16. The stone for the last 50 feet was placed under water.

The following is a detailed statement of cost of repairs to dam:

3,884 cords brush (contract prices)	$4,969.62
74.3 cords poles (contract prices)	111.45
3,034.04 cubic yards stone, delivered on bank	4,966.64
4,499 pounds wire (Nos. 9 and 12)	66.46
4,835 pounds wire strand (one-quarter and five-sixteenths inch)	133.17
Team hire, hauling brush and stone	1,016.23
Towage on brush	1,714.41
22,412 feet lumber (used in track)	256.95
Labor and subsistence (transportation of material)	3,978.80
Labor and subsistence (construction)	2,157.71
Miscellaneous	439.11
Total	19,810.55

The repair work on dam, including foot mats, comprised 287,748 cubic feet and cost $19,810.55, or $0.0688 + per cubic foot.

January 10 the river began rising, and on the 12th was rising at the rate of 4½ feet in twenty-four hours. On Sunday the 13th the water had gotten against the dam on the Tennessee side, and at 2 p. m. that day stood 2.6 feet higher on the upstream than on the downstream side. On that night the water got against the dam on the Elmot Bar side, and at 2 p. m. on the 14th the difference in elevation between the upstream and downstream was 4 feet on the Tennessee side and 2.2 feet on the Elmot Bar side, and on upper side of dam was 0.84 feet higher on the Tennessee than on the Elmot Bar side. On the 15th the water was running over the dam at all points, with a fall of 5 feet. On the 18th, when I left, the fall was 2 feet.

On the night of the 16th a small slide occurred in the bank revetment on the Elmot Bar side, immediately at the end of the dam, but did not extend below the crest of the new work (the 14-foot stage). This slide was about 40 feet wide at the bottom and reached to about the 20 foot contour, and was some 4 feet deep. Having some stone on hand, I hauled and dumped into this hole 118 cubic yards, forming an abutment 6 feet wide on top at the upper end and with a slope of 2 to 1 parallel with the slope of the bank, the hole at the bottom being filled up level to the 17-foot stage. This slide was evidently due to some hidden defect, under the old brush revetment. No further settling occurred after the stone was put in, up to noon of the 18th, when I left, and no apparent change had occurred in the line of the dam.

The party was in the field from October 27 to January 18, a total of eighty-three days. Two days were lost from bad weather, two legal holidays, and eleven Sundays, making sixty-eight working days. The force was kept at work one Sunday on account of the rapidly rising river.

Following is a statement of total cost for the season:

Mat construction as above	$12,340.09
Repairs to dam	19,810.55
Care of plant	1,160.24
Repairs to plant	170.07
Superintendence (including office expenses)	2,258.85
Miscellaneous	240.53
Total	35,980.33

Final abstract, showing cost in detail, is herewith submitted; and also plan showing break No. 2 and hole below; profile of the dam, showing work done this season, and sections showing work done this season.

Very respectfully, your obedient servant,

B. B. GORDON, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers U. S. A.

Statement of expenditures at Gold Dust Dam during season of 1894–95.

Items.	Superintendence and office expenses.	Care of plant. Amount.	Care of plant. Cost.	Repairs to plant.	Repairs to dam. Amount.	Repairs to dam. Cost.
Labor	$2,100.50		$683.52	$118.42		$4,677.18
Team hire						1,016.23
Subsistence:						
Services	45.31		69.42	17.78		346.93
Stores	113.04		178.62	23.13		1,112.40
Brush, cords					3,884	4,969.02
Poles, do					74.3	111.45
Stone, cubic yards					2,974.04	4,906.64
Iron and steel, pounds		209	890		519	8.05
Spikes and nails, do					1,023	25.19
Bolts and nuts				8.00		13.29
Oil and engineers' supplies			30.49			13.64
Lumber, feet						256.95
Wire, strand, pounds						133.17
Wire, black, do						66.46
Coal, bushels		1,243	122.43			77.49
Towage						1,714.41
Manila rope						7.95
Steel rails						145.52
Wire cable						87.58
Pipe fittings, etc						53.73
Miscellaneous			66.86	2.74		6.67
Total	2,258.85		1,160.24	107.07		19,810.55

Items.	Fascine mattresses. Amount.	Fascine mattresses. Cost.	Miscellaneous.	Total. Amount.	Total. Cost.
Labor		$3,444.50	$6.40		$11,030.52
Team hire		657.03			1,673.26
Subsistence:					
Services		244.61	1.10		725.15
Stores		800.55	3.47		2,231.21
Brush, cords	2,450	2,812.70		6,234	7,782.32
Poles, do	6	9.00		80.3	120.45
Stone, cubic yards	1,487	2,483.29		4,461.04	7,449.93
Cable clips, number	1,544	114.39		1,544	114.39
Iron chain, pounds	72	2.88		72	2.88
Iron and steel, do	750	10.87		913	27.82
Spikes and nails, do	1,320	34.46		2,343	59.65
Staples, do	300	6.75		300	6.75
Bolts and nuts		6.64			27.93
Oil and engineers' supplies		24.32			68.45
Lumber, feet		181.98		37,317	438.93
Wire, strand, pounds		298.60		15,475	431.77
Wire, black, do		90.99		10,583	157.45
Coal, bushels		56.47		2,563	256.39
Towage		894.17	200.00		2,808.58
Manila rope		7.94			15.89
Steel rails		72.75			218.27
Wire cable		43.80			131.38
Pipe fittings, etc		26.87			80.60
Miscellaneous		14.53	29.56		120.36
Total		12,340.09	240.53		35,980.33

APPENDIX 5 E.

REPORT OF ASSISTANT ENGINEER W. M. REES ON REPAIRING REVETMENT WORK AT HOPEFIELD BEND, ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., April 10, 1895.

CAPTAIN: I have the honor to submit the following report of the field operations of repairing the revetment work at Hopefield Bend, Arkansas, during the season of 1894:

This work was originally constructed during the stages of the river averaging several feet above the zero of the Memphis gauge. The extreme low water of last fall, when the river fell to below the zero mark, brought to sight much of the hitherto submerged work, showing it to be very lightly ballasted and the brushwork of the mattresses to be in need of repairs in places. It was therefore considered advisable to take advantage of the favorable condition of the river and make the necessary repairs. The work was begun November 20 and continued, with several interruptions, to December 15. From Station 12 to Station 70, a length of 5,800 feet, the bank was repaved along the low-water line, the extreme width of the repaved belt being from 5 feet below the zero contour to 10 feet above contour. At one locality, near Station 55, the matwork along the low-water line was undermined, broken, and somewhat decayed. This place was repaired with a piece of new mattress, well paved over. Owing to the character of the work—principally adding stone to work too lightly ballasted—no attempt is made to give measured quantities of work done. This is better shown by the material consumed.

The cost of paving was:

Labor and subsistence	$1,209.96
2,400 tons (gross) stone	3,552.00
Miscellaneous	3.81
Towing expense	288.34
Total	5,144.11

The cost of connecting mattress was:

Labor and subsistence	76.52
98 cords brush	104.86
100 tons (gross) stone	148.00
Towing expense	22.26
Total	351.64

Total cost of repairs to Hopefield Bend work 5,495.75

Transmitted herewith is a tabulated statement of expenditures, also a map showing location of work.

Very respectfully, your obedient servant,

W. M. REES, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Repairs to existing works—Abstract of expenditures at Hopefield Bend, Ark., during 1894.

Items.	Connecting mattress.		Repairing pavement.		Total.	
	Amount.	Cost.	Amount.	Cost.	Amount.	Cost.
Labor		$70.59		$1,217.40		$1,287.99
Subsistence:						
Service		1.67		22.75		24.42
Supplies		4.26		59.81		64.07
Brush.....cords	98	104.86			98	104.86
Stone.....tons	100	148.00	2,400	3,552.00	2,500	3,700.00
Coal		9.47		125.84		135.31
Oil and Engineer's supplies		.29		3.81		4.10
Charter of steamers		12.50		162.50		175.00
Total		351.64		5,144.11		5,495.75

APPENDIX 5 F.

REPORT OF ASSISTANT ENGINEER W. M. REES ON IMPROVEMENT OF HARBOR AT MEMPHIS, TENN.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., April 10, 1895.

CAPTAIN: I have the honor to submit the following report on improving Memphis Harbor during the working season of 1894:

The project embraced the revetment of the bank southward from the lower end of the system of dikes constructed in 1886 as far as the funds would permit. The work is situated along the lower portion of the harbor of Memphis, the bank being of the "bluff formation," with its top about 100 feet above low water, or 65 feet above high water.

During flood stages the current has been quite strong, causing steady but not very rapid erosion, as the hard clays forming the bank resist scour much better than the alluvial deposits.

The revetment work comprised placing a heavy fascine mattress from the zero stage 300 feet wide riverwards and paving the slope above this with a layer of broken stone about 1 foot thick and extending to about the 21-foot stage of the river.

Construction.—The plant used was brought from the work at New Madrid, Mo., on November 8, and after repairing and remodeling it active construction was begun November 13.

The season was very favorable, the river remaining nearly stationary at the zero mark during the entire work. Only two and one-half days were lost by rain, but the work was suspended for seven days in addition on account of shortage in the brush supply, the brush destined for this work being sent to Plum Point Reach, where work of greater importance was at the time in progress.

Labor and material.—Labor was abundant and of good quality. The maximum force employed was 220. Brush and poles were obtained by contract at $1.07 per cord for brush and $1.50 per cord for poles, delivered on Government barges at the camps, which were from 50 to 70 miles below the work, and required the employment of two steamboats during the time the fascine mattress was being built, as the daily consumption when under full headway was fully 500 cords. The towage cost was 52 cents per cord. Stone was obtained by contract delivered on Government barges at West Memphis, Ark. The prices paid were $1.48 per gross ton for riprap and $1.33 for spalls. The stone was quarried at Williford, Ark., and brought to the delivery point by railroad. The cost of towing stone to the work was 2 cents per gross ton.

Fascine mattresses.—The arrangement of plant and method of construction was the same as employed at Hopefield Bend, Arkansas, and at Plum Point Reach during the season of 1893–94, detailed descriptions of which were published in the last Annual Report of the Mississippi River Commission.

But one mattress was constructed, the work beginning November 13 and ending with its sinking, December 8. Its length was 1,260 feet, width 300 feet, containing 3,780 squares. The head was located 100 feet below the crest of Dike No. 5, the foot mat of which it laps by about 25 feet.

The cost in detail was—

Labor and subsistence	$5,158.61
5,521.7 cords brush	5,908.23
129.53 cords poles	213.67
3,000 tons (gross) stone	4,440.00
12,004 pounds wire, steel	177.71
3,928 pounds wire, silicon bronze	597.32
36,918 pounds wire, strand	1,039.77
4,914 clips	189.00
900 pounds staples	20.50
Spikes and nails	2.25
Piling	12.00
Manila rope	473.23
Steel cables	263.17
Miscellaneous materials	22.00
Superintendence	469.50
Care of plant	559.30
Repairs to plant	187.20
Towing expense	2,811.88
Miscellaneous expense	250.00
Total	22,795.34
Cost per linear foot for mattresses 300 feet wide	18.09
Cost per square of 100 square feet	6.03

The average quantities of material used per square was—

Brush	cords..	1.46
Poles	do....	.034
Stone	gross tons..	.793
Wire, strand	pounds..	9.766
Wire, steel	do....	3.176
Wire, silicon bronze	do....	1.039
Staples	do....	.238
Clips		1.3

Connecting mattresses.—Owing to the curved shape of the bank at the water-line contour a series of connecting mats were placed along the entire length of the river mattress. These had their upper edges well out of the water to render a good connection with the paving, and overlapped the river mattress about 10 feet. They were of the fascine type, with fascines parallel with the bank.

The total squares made was 390. The cost in detail was:

Labor and subsistence	$522.02
454.39 cords brush	486.19
300 tons (gross) stone	444.00
523 pounds wire, strand	15.43
708 pounds wire, steel	10.63
25 pounds staples	.62
Superintendence	68.04
Care of plant	57.50
Towing expense	300.50
Miscellaneous expense	40.00
Total	1,944.93
Cost per square of 100 square feet	4.98

Grading.—No hydraulic grading was done, as the bank had a good natural slope, and this was trimmed up by hand shoveling as the paving advanced from the water line upward, the earth being cast on top of the paving, making a cheap method of doing the work. The total cost of hand grading was $849.59, or $0.674 per linear foot of bank paved. This is charged in the paving account.

Paving.—This work was begun December 12, 1894, and completed January 10, 1895. It covers the entire length of the river mattress, extending from 1 foot below the zero stage to the 21-foot stage above zero. Its average thickness was 12 inches, of which the lower 4 inches was quarry spalls and the upper 8 inches small riprap closely placed.

The total paving equals 10,235 square yards. The cost in detail was:

Labor and subsistence	$2,725.57
3,955.95 gross tons stone	5,591.29
Miscellaneous material	2.30
Superintendence	350.00
Care of plant	440.79
Repairs to plant	166.37
Towing expense	310.06
Miscellaneous expense	200.00
Total	9,786.38

Cost per square yard, $0.956.

Following is a summary of work and cost:

River mattress, 1,260 by 300 feet, 3,780 squares	$22,795.34
Connecting mattresses, 390 squares	1,944.93
Paving, 1,260 linear feet, 10,235 square yards	9,786.38
Total cost of revetting 1,260 linear feet of bank	34,526.65

Cost per linear foot of revetment, $27.40.

Transmitted herewith is a tabulated statement of expenditures, also a map showing location of work.

Very respectfully, your obedient servant,

W. M. REES, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Abstract of expenditures at Memphis Harbor for 1894–95.

Items.	Superintendence.	Care of plant.	Repairs to plant.	Miscellaneous.	Towboats.		River mattress.	
					Graham.	Patton.	Amount.	Cost.
Labor	$789.75	$555.84	$218.00	$306.59	$847.99	$673.50	.....	$4,689.39
Subsistence:								
Service	26.93	74.69	13.15	45.10	77.33	46.17	.....	129.50
Supplies	70.86	196.52	34.67	118.21	196.25	111.48	.....	329.72
Brush.....cords	.....	.....	.....	.....	.....	.....	5,521.70	5,908.23
Poles.....do	.....	.....	.....	.....	.....	.....	129.53	213.67
Stone.....tons	.....	.....	.....	.....	.....	.....	3,000	4,440.00
Wire strand.....pounds	.....	.....	.....	.....	.....	.....	36,918	1,039.77
Wire, annealed.....do	.....	.....	.....	.....	.....	.....	12,004	177.71
Wire, silicon bronze.....do	.....	.....	.....	.....	.....	.....	3,928	597.32
Staples.....do	.....	.....	.....	.....	.....	.....	900	20.50
Cable clips.....number	.....	.....	.....	.....	.....	.....	4,914	189.00
Spikes and nails	.....	.....	.....	.....	.....	.....	.....	2.25
Piling	.....	.....	.....	.....	.....	.....	.....	12.00
Lumber	.....	.....	52.32	.....	.....	.....	.....	.....
Coal	.....	173.40	.....	.....	437.71	320.18	.....	.....
Oil and engineer's supplies	.....	32.04	.....	.....	21.94	4.33	.....	.....
Manila rope	.....	.....	.....	.....	.....	.....	.....	473.23
Cables	.....	.....	.....	.....	.....	.....	.....	263.17
Charter of steamers	.....	.....	.....	.....	.....	650.00	.....	.....
Repairs to steamers	.....	.....	.....	.....	30.25	.....	.....	.....
Miscellaneous	.....	25.10	35.43	20.10	5.31	.....	.....	22.00
Total	887.54	1,057.59	353.57	490.00	1,616.78	1,805.66	.....	18,517.46

Items.	Connecting mattress		Bank revetment.			Total, 1,260 linear feet of revetment.		Quantities per square of river mattress.
			Hand grading (cost).	Paving.				
	Amount.	Cost.		Amount.	Cost.	Amount.	Cost.	
Labor	.....	$502.70	$782.52	.....	$1,802.68	.....	$11,168.96	.....
Subsistence:								
Service	.....	5.32	17.85	.....	20.40	.....	456.44	.....
Supplies	.....	14.00	46.92	.....	55.20	.....	1,183.83	.....
Brush.....cords	454.39	486.19	.....	.....	.....	6,074.09	6,394.42	1.460
Poles.....do	.....	.....	.....	.....	.....	129.53	213.67	.034
Stone.....tons	300	444.00	.....	3,955.95	5,591.29	7,255.95	10,475.29	.793
Wire strand.....pounds	523	15.43	.....	.....	.....	37,441	1,055.20	9.766
Wire, annealed.....do	708	10.63	.....	.....	.....	12,712	188.34	3.176
Wire, silicon bronze.do	.....	.....	.....	.....	.....	3,928	597.32	1.039
Staples.....do	25	.62	.....	.....	.....	925	21.12	.238
Cable clips.....number	.....	.....	.....	.....	.....	4,914	189.00	1.300
Spikes and nails	.....	.....	.....	.....	.....	.....	2.25	.....
Piling	.....	.....	.....	.....	.....	.....	12.00	.....
Lumber	.....	.....	.....	.....	.....	.....	52.32	.....
Coal	.....	.....	.....	.....	.....	.....	931.29	.....
Oil and engineer's supplies	.....	.....	.....	.....	.....	.....	58.31	.....
Manila rope	.....	.....	.....	.....	.....	.....	473.23	.....
Cables	.....	.....	.....	.....	.....	.....	263.17	.....
Charter of steamers	.....	.....	.....	.....	.....	.....	650.00	.....
Repairs to steamers	.....	.....	.....	.....	.....	.....	30.25	.....
Miscellaneous	.....	.....	2.30	.....	.....	.....	110.24	.....
Total	.....	1,478.89	849.59	.....	7,469.57	.....	34,526.65	.....

APPENDIX 5 G.

REPORT OF ASSISTANT ENGINEER AUG. J. NOLTY ON CARE OF AND REPAIRS TO PLANT.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., April 30, 1895.

CAPTAIN: I have the honor to submit my report of operations of, the care of, and repairs to plant for the twelve months ending April 30, 1895:

From September 25, 1894, to January 13, 1895, the period of my absence on construction work at Plum Point Reach, Mr. J. E. Prewitt, receiver of materials, was in local charge of this party.

Steamer Minnetonka.—Extensive repairs to this boat were begun in April, 1894, and completed in July of the same year. These repairs consisted in new deck and deck beams, new outriggers, guards, fantails, pitmen, smokestacks, extensive repairs to breeching furnaces and fire bed, wheel, and rudders, thorough overhauling of engines,

pumps, and other machinery, including the boring out of the main cylinders and in painting the boat inside and out. This boat went into commission September 13, towing plant for the work at Hickman, Ky. Returning from this place light, when opposite Idaho Landing, Arkansas, September 19, the boat struck a submerged snag and sank immediately in 15 feet of water. The work of raising was begun as soon as the necessary appliances for the work could be gotten up there, and the boat was successfully raised October 11. It was then towed up to Mound City, Ill., to be taken out on the ways and have a new hull put under the upper works. The wrecking operations were conducted under the supervision of Mr. W. M. Rees, assistant engineer in charge. On the 19th of April, 1895, the *Minnetonka* was received back from Mound City. The finishing touches, such as painting, putting on new roof, erecting stacks, completing repairs to engines and boilers, etc., were done here, and the boat is now ready for service. Present condition of boat, very good.

Steamer Titan.—This boat was docked in May, 1894, and received repairs to hull, cabin, and machinery. In February, 1895, after a long season's towing, more extensive repairs were necessary. These repairs, which were completed by the end of March, consisted in putting in two new outboard cylinder timbers, cutting out 20 feet of decayed wood from one of the main cylinder timbers and splicing in a new piece, putting in new foundation and deck under both engines, new outriggers, and guards all around, new fantails, new cutting strake all around, new roof covering put over main cabin and balance of roof repaired, new head built and deck on forecastle repaired, new fire door and poker hole liners put in, furnace rebuilt, cabins repaired, painted, and varnished, wornout capstan and capstan engine removed and replaced with new outfit, main engines repaired and lined up, doctor repaired, wheel rebuilt and boat calked from light load line up. This boat was put into the stone towage service on April 1. Present condition of boat, good.

Steamer H. M. Graham.—This boat was painted in May, 1894, at which time it also received some minor repairs. In March and April, 1895, more extensive repairs were required. These consisted in new deck beams and new deck under engines and boilers, cutting out 18 feet of decayed cylinder timber and splicing in a new piece, repairs to roof, fantail, wheel, and guards, building new head and laying deck on forecastle, repairs to engines and lining them up and repairing capstan. Present condition only fair, and hull not worthy of further extensive repairs. Boat is good for one year's service.

Tug Itasca.—Received repairs in September, 1894, and in March, 1895. These comprised new breeching, repairs to capstan, laying new deck over bow, repairing main throttle valve, and scraping and painting the interior of the skin. Present condition, very good.

Launch H. L. Abbot.—Minor repairs only were required. Present condition, good.

Machine-shop boats Nos. 1 and 2.—Received minor repairs only, such as putting in new timber heads, repairing guards, repairing gunwales, covering boilers, etc. Engine on No. 2 was repaired and shafting lined up. No. 2 also received an addition of one 16-inch planer and shaper to its outfit. Present condition of both, fair.

Hydraulic grader No. 2.—This piece was docked and received extensive repairs in July and August, 1894. These consisted, in addition to repairing and calking bottom and sides, in the building of an entire new foundation under the pumps and boilers, putting in a heavy set of transverse trusses under the former, resetting and relining engines and boilers, rebuilding furnaces and testing boilers. Two test pieces were cut out of each boiler, both on this grader and on No. 4, and these were submitted to the United States inspector of steam boilers. These pieces showed remarkably well when it is considered that the boilers have been in service since 1882. The original thickness of shell was 0.26, that found from the test pieces was 0.23 for boilers on No. 4 and 0.22 for those on No. 2. Steam pressure allowed by inspector, 130 pounds for No. 4 and 125 pounds for No. 2. Pressure required for work, 100 pounds. This machine will require some repairs this season. Present condition, fair.

Grader No. 4.—In August and September, 1894, a new foundation and deck were placed under the boilers. The machinery was overhauled and put in good order, a new stack was made and erected, and the hull calked. The pumps are now being overhauled, and a new deck has been laid under the hoisting engine. Two low-pressure cylinders of one of the Worthington pumps require boring out. Present condition, fair.

Grader No. 40.—A new water chamber, to replace a bursted one, was put on this machine. Slight repairs were made to hull and one new stack put up. More extensive repairs will be required before the opening of this season's construction work. Present condition, only fair.

Pile drivers Nos. 19 and 21.—These, after receiving new gunwales and rakes in April, 1894, had their upper works finished, new leads erected, machinery repaired, and hull and cabin painted. No. 19 received a new water chamber in April, 1895, and is now awaiting a new water plunger for one of the pumps. Both drivers are in good condition. No. 21 has been transferred to the experimental dredge.

Pile driver No. 20.—Received new gunwales, rakes, deck, and leads. Had machinery overhauled and boiler patched, and hull and cabin were painted. Present condition, good.

Pile driver No. 61.—This piece has been entirely rebuilt, having received a new hull, new deck, and new sills for the leads. The latter will not be erected at present, as it is intended to first use this driver for operations in Wolf River. For this purpose a set of shears will be put up with which it is intended to remove sunken logs and snags. Upon completion of this work the leads will be put up and the driver will then be transferred to the new dredge. Present condition, very good.

Pile drivers Nos. 26 and 27.—These had the machinery removed and were then docked, patched, and calked, and were fitted up for use as quarter boats and hand-power snag boats for use on improvement of Hatchie and Forked Deer rivers. The cost of this work was paid for by Capt. J. H. Willard, Corps of Engineers, U. S. A., to whom they were loaned for the above work. No. 27 was condemned and sold in 1895. Condition of No. 26, poor.

Quarter boats Nos. 6, 12, 25, and 8.—All docked, calked, and received only repairs sufficient to make them seaworthy for the past season's work. They were cleaned and whitewashed and had ranges and flues repaired. Four new coal barges were purchased last fall, and it is intended to move the cabins from the three worst hulls upon three of the new ones, the old hulls being beyond repair.

Quarter boat No. 13.—Received repairs to hull, including new guards all around. Also received minor repairs to cabin. One of the new hulls has been prepared and the cabin has been transferred to it, the old hull being beyond repair. Present condition, very good. The boat will probably be tranferred to the new dredge.

Quarter boat No. 11.—In May, 1894, the cabin of this boat was transferred to a new hull, the old one being beyond repair. One extra tier of double bunks was added so as to increase the capacity of the boat. The boat was cleaned and whitewashed, had stoves, ranges, and flues repaired, and foremen's rooms painted. Present condition, good.

Quarter boat No. 26.—(Material store boat.) Received only minor repairs to hull and cabin. Present condition, good.

Quarter boat No. 39 and Mississippi.—Received only slight repairs. Six new fenders were made for the former boat. Present condition, good.

Quarter boat Amelia (No. 2).—Was docked and calked. Had rake repaired; also minor repairs to cabin and guards. Will require repairs to guards and deck shortly. Present condition, fair.

Bake-shop boat No. 10.—Was docked and received only such repairs as would make it serviceable for the past season's construction work. Cabin good, but hull not worthy of repair.

Experimental dredge.—This boat is now receiving extensive alterations and additions. The cabin has been extended both forward and aft, and a second story, to be used for the accommodation of officers and crew, is being added. Floating pipes have been docked, scraped and painted, and repaired where necessary. The test barge was docked and four blow-out siphons put in. The small flat belonging to the dredge was docked, repaired, and calked. A large Davidson steam pump has been fitted up for use; also a boiler formerly belonging to the launch *Daphne*.

Floating dock.—This piece was thoroughly repaired, receiving new gates at each end, new floor stringers throughout, new timber heads, new top chords, new ballast tanks, and was calked and painted.

Fuel flats.—One of these, for use with the experimental dredge, has been built. Its dimensions are: Length, 81 feet; beam, 18 feet; and depth, 6 feet. Another one, intended for the new dredge, is now in course of construction. It will be 7 feet deep. Other dimensions will be similar to No. 1.

New barges.—Ten model barges were built by contract in 1894. These were completed in time to be available during the latter part of construction work of the past season, and greatly relieved the shortage in barges. As none of these barges were fitted with bilge pumps, these, two for each barge, have been fabricated here.

Framed barges.—Nos. 206, 208, and 213 were docked and thoroughly repaired on bottom and rakes. They received new head blocks, new timber heads, had sides patched, and were calked all around and on deck. New decks were laid on these barges Nos. 211, 221, and 223 were docked and received repairs like those above, except that in lieu of new decks the old ones were simply patched. Nos. 227, 228, 229, 203, and 209 were not docked, but received new decks, timber heads, head blocks, had sides patched, and were calked all around and on deck. Nos. 202, 215, and 218 had decks patched, received minor repairs to hulls, and were calked all around. Barge No. 227 was docked in March, 1895, and was thoroughly rebuilt, receiving new sides from the bottom up, new rakes, new head blocks, and was calked all around. All the other barges of the class designated "framed" will have to be treated this season like 227. All necessary lumber for doing this work is now on hand. This will practically make these barges as good as new, as the framing and the bottoms are quite sound.

Gunwale barges.—These were built in 1893. Nos. 9301, 9302, 9305, 9310, 9315, 9316, 9318, 9327, 9321, 9328, 9324, and 9329 were calked from the light load line up. Present condition, good. Mattress barges Nos. 1, 2, 3, 4 received minor repairs sufficient to fit them for the season's work. Present condition, only fair.

Mooring barges Nos. 1. 2, 3, 4 received repairs similar to the mat barges. Present condition, two unfit for further service and two fair.

Fascine barges Nos. 173, 178, and 193 are some of the old general service barges. They have received only repairs sufficient to make them serviceable for the past season's work. They are not worthy of further repairs.

Barges Nos. 55, 74, 134, 76, and 94 were calked and received minor repairs. Two of these were fitted up for service as landing barges by having four fenders put up on one side of each.

Miscellaneous repairs.—A large amount of work that can not be properly classified was done to floating plant, tools and appliances, and chartered steamers.

United States warehouse.—A sudden cave-in of the bank in front of the warehouse at Elmot, Ark., necessitated the removal of it. About 50 feet of the warehouse was destroyed by the caving, and all machinery stored in that part of the warehouse, as well as a lot stored outside and in front, caved in with the bank. Considerable of this was recovered and more can be saved at low water. The warehouse was moved back 300 feet, repaired, and the machinery, which had been taken out to facilitate moving, restored. Assistant Engineer Charles LeVasseur was in charge of this work.

The abstract of expenditures accompanying this report shows the cost of repairs to and care of plant in detail.

Respectfully submitted.

AUG. J. NOLTY, *Assistant Engineer.*

CAPT. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Cost of care of and repairs to plant from May 1, 1894, to May 1, 1895.

Steamer *Minnetonka*	$14,782.15	Barge No. 211	$120.37
Steamer *Titan*	3,606.10	Barge No. 213	789.04
Steamer *H. M. Graham*	984.54	Barge No. 215	256.46
Steamer *Itasca*	727.03	Barge No. 218	298.32
Steamer *H. L. Abbot*	120.60	Barge No. 221	468.61
Steamer *Jay Gould*	26.43	Barge No. 223	56.17
Pile driver No. 19	913.56	Barge No. 227	1,711.10
Pile driver No. 20	1,368.03	Barge No. 228	582.47
Pile driver No. 21	922.36	Barge No. 229	375.89
Pile driver No. 61	859.67	Barge No. 9301	31.84
Quarter boat No. 6	454.73	Barge No. 9302	27.25
Quarter boat No. 8	66.01	Barge No. 9303	56.72
Quarter boat No. 10	71.24	Barge No. 9304	17.68
Quarter boat No. 11	860.86	Barge No. 9305	64.51
Quarter boat No. 12	706.34	Barge No. 9306	52.12
Quarter boat No. 13	134.54	Barge No. 9307	60.70
Quarter boat No. 25	634.00	Barge No. 9308	36.11
Quarter boat No. 26	37.40	Barge No. 9309	25.79
Quarter boat No. 27	60.01	Barge No. 9310	30.95
Quarter boat No. 39	72.57	Barge No. 9311	28.03
Quarter boat No. 206	2,401.18	Barge No. 9312	64.58
Quarter boat No. 221	2,173.57	Barge No. 9313	3.95
Quarter boat *Amelia*	172.46	Barge No. 9314	19.93
Barge No. 55	49.79	Barge No. 9315	51.50
Barge No. 74	5.85	Barge No. 9316	49.70
Barge No. 76	5.86	Barge No. 9318	37.02
Barge No. 94	5.86	Barge No. 9319	66.51
Barge No. 134	25.09	Barge No. 9320	32.04
Barge No. 143	1.20	Barge No. 9321	26.12
Barge No. 171	17.31	Barge No. 9322	34.82
Barge No. 173	17.60	Barge No. 9323	34.79
Barge No. 178	111.92	Barge No. 9324	42.45
Barge No. 193	76.47	Barge No. 9325	13.24
Barge No. 202	106.28	Barge No. 9326	42.80
Barge No. 203	377.42	Barge No. 9327	66.28
Barge No. 206	752.33	Barge No. 9328	26.89
Barge No. 208	605.50	Barge No. 9329	27.92
Barge No. 209	1,143.65	Mooring barge No. 1	22.91

Cost of care of and repairs to plant from May 1, 1894, to May 1, 1895—Continued.

Mooring barge No. 2	$103.52	Tools and appliances	$1,820.24
Mooring barge No. 4	151.96	Artesian well	191.96
Mattress barge No. 1	17.75	General repairs	2,216.40
Mattress barge No. 2	17.76	Towing	3,288.26
Mattress barge No. 3	66.29	Raising steamer *Minnetonka*	8,314.52
Mattress barge No. 4	66.29	Care of plant	14,355.18
Hydraulic grader No. 2	1,727.33	Care of plant, steamer *Minnetonka*	658.17
Hydraulic grader No. 4	430.19	Test barge	164.70
Hydraulic grader No. 40	826.43	Floating dock	1,533.86
Dredge	1,432.32	Machine boat No. 1	7.50
Floating pipe	422.40	Machine boat No. 2	302.33
Fuel flat No. 1	853.41		
Fuel flat No. 2	23.50	Total	81,228.29
Skiffs	38.40		
Storehouse	986.64		

Includes $5,452.51, repairs in 1894.

APPENDIX 5 H.

REPORT OF ASSISTANT ENGINEER C. W. STURTEVANT ON THE WORK OF UNITED STATES EXPERIMENTAL DREDGE.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., May 17, 1895.

CAPTAIN: I have the honor to submit the following annual report upon the work of the United States experimental dredge from June 1, 1894, to date:

June 1, 1894, the dredge was at Memphis, Tenn. A new wheel had just been placed in Allis jet pump. It was tested and found to exceed the requirements of the contract and was received.

The Allis sand pump had been removed and the Edwards pump had been connected to the forward suction pipe. Satisfactory tests were made to determine if the forward suction would take up the sand when attached to the Edwards pump.

A wooden box with open ends and bottom was attached to the last floating pipe so that the force of the discharged stream against the downstream side of the box would counteract the upper and swinging movement of the pipes. This proved successful and was replaced by an iron plate.

On July 1 the dredging plant left for St. Louis, Mo., where changes were made in the winding engines, velocimeter tubes, nozzles on jets, and repairs to floating pipes.

On July 17, 1894, moved to sand bar 1½ miles above Merchants Bridge at St. Louis, Mo., to experiment with all parts of the dredging plant under the immediate supervision of Col. Henry Flad. The results of the experiments are as follows:

Anchors for side lines are not as suitable as piles. In very slack current the driftwood in the sand would clog the suction strainer, while in swift water the drift would generally float off when liberated instead of being drawn in by the suction. The sand was stirred up by six hydraulic jets, each 2½ inches diameter, under a head of from 18 to 21 feet.

A survey was made before and after dredging to determine the amount excavated which was 4,108 cubic yards.

Total time actual pumping was nineteen and one-half hours, or about 210 cubic yards per hour. Black mud was constantly being deposited in the cut and on top of the sand, which was also mixed with mud and driftwood, the site for experiments having been located immediately under a reef in slack water. The engines used to move the dredge ahead are not properly geared. The movement is so fast that the engines have to be started and stopped continually. If geared so that engines may be run steady and the drum have a slow and constant motion the feed or entrance of sand into the suction pipe would be more even. Experiments were continued at this place with handling of dredge by side lines to piles and overhauling weighing apparatus.

On August 11 received orders to move outfit to Liberty Island so that the experiments might be continued in swift current and in clear sand, such as found in the channels.

On arriving at Liberty Island received orders to go to Cairo, Ill., or below, where experiments would not interfere with navigation.

At Cherokee Crossing, 88 miles below Cairo, there are two channels, the steamboats using the upper one. The lower channel was, however, deep enough for our pur-

pose, the sand coarse, and current swift, the shallow portion being about 6,000 feet long. Commenced actual dredging September 5, meanwhile experimenting with floating pipe by swinging to one side by means of side lines so as to deposit the sand out of the channel.

The winding engines that moved the dredge ahead were regulated by a man from the roof, where the floating pipe could be seen, and the rate of movement ahead was regulated by observing the height of flotation of the pipes as well as suction and delivery head. The weighing apparatus was also used in this connection, but required constant attention.

With 530 feet of floating pipe in such a long channel the sand could not be deposited far enough from the cut and was carried back into the channel again lower down, so that the material had to be rehandled. The channel was improved both in depth and width where dredged, but would fill up again in places lower down where before it had been sufficiently deep.

On October 10 received orders to go to Flora Creek Crossing, above Cape Girardeau, Mo., to make an actual working test in the channel for the passage of boats.

Arrived at Flora Creek October 18, 1894. The steamboat channel at that time was down the Illinois shore along Devils Island, Minton Point, through gap in Wahoo Dike to levee at Cape Girardeau, Mo., with two long shallow stretches at foot of Devils Island and gap in Wahoo Dike. Depth of water at both shoals 4½ feet.

There was also deep water from Cape Girardeau up along the Missouri shore to Flora Creek, and to make a good channel it was only necessary to connect the upper end of this pool with the lower end of the pool just above the foot of Devils Island. Although the water was only from 3¾ to 4 feet deep there was only one reef to cut through, and that for a distance of 1,600 feet, with a large area of deep water immediately below for depositing the dredged material.

The floating pipes were coupled up and dredging commenced at the lower end of the intended channel at 4.35 p. m. October 19, 1894.

The dredge was moved ahead by two cables attached to piles about 24 feet apart and 12 feet on either side of the tenter line to be dredged.

The lower end of the floating pipes was deflected about 200 feet out from the center line by side lines to side piles. Length of the floating pipe line was 530 feet.

The following table gives number of hours actual dredging. The remainder of the ten hours each day was spent in coupling pipes, changing lines, and moving dredge back for a new cut:

1894.	Number of hours.		Remarks.
	Dredging.	Other work.	
October 18	.....	2¾	Arrived at Flora Creek at 2.15 p. m.
October 19	¼	9¾	
October 20	8	2	
October 21	.....	.....	Sunday.
October 22	9½	½	
October 23	6	4	
October 24	8¾	1¼	
October 25	8½	1½	
October 26	8¼	1¾	
Total	49½	23½	Total 72¾ hours.

From the time the plant arrived at the place it required twelve and one-half working hours to have everything arranged to start the pump. The dredge was moved out of the cut and tied up to the Missouri shore and the steamer *Sidney Dillon* passed up through the channel and found 6½ feet of steamboat water.

During the afternoon of October 27 the *Dolphin* and the *General Casey*, each with tows, and the sidewheel steamer *Idlewild* with two lighters passed through without trouble.

On October 28 the following steamers passed through without delay: *Grey Eagle*, *Wash Honshall* with tow of stone barges four wide, *H. M. Graham* with tow of stone barges three wide, *Dolphin No. 2* with empty tow, and the *Joy Patton* with two stone barges.

Boats continued to use this channel the rest of the season.

On October 27 500 linear feet of floating pipe was received, so that the entire length of floating pipe was about 1,030 feet. The pipes were at once coupled up. Two cast-iron flanges were riveted on pipes so that a flexible rubber joint 6 feet long could be placed in the line of pipe.

Received orders October 31 to proceed with outfit to Liberty Island. At 4.30 p.m. steamer *Polar Wave* with tow of three loaded barges came down broadside and

went aground at both ends across the new channel, remaining there until noon next day. The boat remaining so long across the channel caused a lump to form in the cut, so that the dredge, drawing 4½ feet, could not be steered up the channel. The dredge was again placed in position and the channel opened up. The additional 500 feet of floating pipe was attached and the dredge moved to side of channel and continued to widen the channel until the Mississippi River Commission came by, on November 9, and inspected the working of the plant.

The measuring barge for testing the capacity of the pump was received on same day. Experiments were to have been made at that place with the barge, but it was found necessary to place the barge on a dock in order to make changes in the valve.

Left for Memphis, Tenn., November 14.

The measuring barge was placed on dock and necessary changes made; meanwhile the dredge and floating pipe were connected up ready for testing.

The valve still worked badly and the first accurate test was made December 11, 1894, after which the valve was properly manipulated. The tests were made in the following manner: The measuring barge was attached to the lower end of the floating pipe by a flexible rubber joint 30 inches diameter and 6 feet long. In the end of the barge was an iron valve which was used to deflect the discharged stream either into the barge or downward into the river.

The dredge was held in position and moved ahead in the usual manner by head cables and side lines. It was found necessary to drag an anchor from the stern of the measuring barge.

The low velocity of the discharged stream against the stern bulkhead was not sufficient to overcome the kinking action of the pipes.

When ready to make a test the suction was lowered into the water, but not on the bottom, and clear water was pumped for some time. The suction was then lowered to the desired depth. A man was stationed at each of the following places to make records during the test:

(1) Steam indicators on Edwards engine.
(2) Count revolutions of Edwards engine and note steam pressure.
(3) Delivery head of discharge pipe of Edwards pump.
(4) Vacuum gauge on suction pipe of Edwards pump.
(5) Weighing apparatus.
(6) Velocimeter.
(7) Two opposite gauges near bow of measuring barge.
(8) Two opposite gauges at center of measuring barge.
(9) Two opposite gauges at stern of measuring barge.
(10) Valve of measuring barge with stop watch to note number of seconds valve in measuring barge was open.

The dredge was then moved forward by the two head cables on the winding drums, the sand and water being discharged into the river through the bottom of the valve in the measuring barge.

The movement ahead and discharge of sand and water would be continued for twenty or thirty minutes, when a signal was given to commence reading instruments on the dredge.

Readings were taken at intervals of fifteen seconds. The mean of these readings are entered in the table inclosed herewith. A blast of the steam whistle was made at each reading so that they might all be made at the same instant.

At the first blast of the steam whistle gauges in the measuring barge were read, the barge having previously filled with clear water so that all parts of the false floor were covered. At the third blast of the whistle the valve in barge was opened and second hand of stop watch started. When the barge was as full as was thought safe the valve was closed and hand of watch stopped.

The signal was given that the test was over and the gauges in measuring barge were then read. The barge was emptied of the water, after which the sand was measured in a box 1 by 5 by 10 feet, equal to 50 cubic feet. The rapidly rising river made it necessary to move the dredge every three or four days, and generally only one test could be made per day if a large quantity of sand was deposited in the barge.

In filling the barge the principal part of the sand was generally deposited on one side or the other (very seldom evenly distributed). This would list the barge and it could only be filled until the low side sank to the desired depth.

Examinations of the table show that the capacity per hour is greatest when percentage of sand was largest. The percentage might be so large that capacity would be reduced, owing to the pump being unable to move a stream containing that percentage, but in no test was that percentage attained. In fact, it would indicate that the largest capacity was when the pipes were obstructed with sand so that a less-sized stream was discharged, but under greater head and containing a larger percentage in the actual moving stream.

On January 3, 1895, the runner came off the shaft of the Edwards pump, and, as the river was rising rapidly, the dredge was laid up and crew discharged. Three plans were then made for changing the dredge for permanent use. On March 20, 1895, received orders to proceed with changes as described below:

Extend present cabin both forward and aft; build a second-story cabin full length for quarters; reverse Edwards pump so that its suction pipe will lead direct to the forward suction pipe, which was originally connected with the Allis sand pump; move jet pump to starboard side of forward cockpit to admit passage of the Edwards suction pipe; place on board donkey boiler, extra feed pumps, turning lathe, drill press, and electric-light plant with three droplights, one headlight, and seventy incandescent lights; remodel the winding engines for slow speed.

All changes to machinery mentioned have been made, except the small pipe connections for the steam and water to be distributed about the boat.

The frame of the cabin is up and bulkheads, floors, and roof are nearly finished.

The boat will be finished about July 1, 1895.

Respectfully submitted.

C. W. STURTEVANT, *Assistant Engineer.*

Capt. GRAHAM D. FITCH,
Corps of Engineers, U. S. A.

Table of tests of the United States experimental dredge, as determined by the measuring barge.

No. of test.	Date.	Time.	Conditions.													
			Suction pipe.											Discharge pipe.		
			Lowered below surface of water.	Diameter.	Length from suction head to pump.	Rate of movement ahead of dredge, foot per second.	Suction head.		Jets.					Diameter.	Length from end of dredge to valve in barge.	Length from pump to valve in barge.
							Man heads.	Gates.	Number.	Diameter.	Delivery head (feet of water).	Revolution of jet pump.				
			Ft.	In.	Ft.					In.				In.	Feet.	Feet.
7	Dec. 11, 1894	3.30 p. m.	10	30	101	0.075	On	Removed	6	2.5	20.5	224		30	547.5	604.5
8	Dec. 12, 1894	10.25 a. m.	12	30	101	.071	On	Removed	6	2.5	20.3	224		30	547.5	604.5
9	Dec. 13, 1894	7.59 a. m.	12	30	101	.037	On	Removed	6	2.5	21	234		30	547.5	604.5
10	...do	3.18 p. m.	12	30	101	.045	On	Removed	6	2.5	20.8	230		30	547.5	604.5
11	Dec. 14, 1894	10.20 a. m.	12	30	101	.058	On	Removed	6	2.5	20.9	230		30	547.5	604.5
12	Dec. 15, 1894	9.15 a. m.	12	30	101	.037	Removed	Removed	6	2.5	20.1	228		30	547.5	604.5
13	Dec. 17, 1894	8.27 a. m.	12	30	101	.037	Removed	Removed	6	2.5	21	230		30	547.5	604.5
14	Dec. 18, 1894	1.25 p. m.	12	30	101	.037	Removed	Removed	6	2.5	19.8	226		30	547.5	604.5
15	Dec. 19, 1894	1.43 p. m.	12	30	101	.030	On	Removed	6	2.5	21	236		30	547.5	604.5
16	Dec. 24, 1894	10.35 a. m.	12	30	101	.037	On	Removed	6	2.5	20.5	228		30	1,002.5	1,059.5
17	Dec. 26, 1894	12.35 p. m.	12	30	101	.025	On	Removed	6	2.5	20.2	224		30	1,002.5	1,059.5
18	Dec. 27, 1894	10.31 a. m.	12	30	101	.030	On	Removed	6	2.5	20.8	230		30	1,002.5	1,059.5
19	Dec. 29, 1894	10.17 a. m.	12	30	101	.050	Removed	Removed	6	2.5	20.2	222		30	1,002.5	1,059.5
20	Dec. 31, 1894	11.05 a. m.	12	30	101	.021	Removed	Removed	6	2.5	19.8	216		30	1,002.5	1,059.5
21	Jan. 1, 1895	9.24 a. m.	12	30	101	.050	Removed	Removed	6	2.5	21	230		30	1,002.5	1,059.5
22	Jan. 2, 1895	9.47 a. m.	12	30	101	.050	Removed	Removed	6	2.5	20	226		30	1,002.5	1,059.5

Table of tests of the United States experimental dredge, etc.—Continued.

No. of test.	Date.	Time.	Edwards pump.												
			Revolutions per minute.	Steam pressure.	Indicated horse-power.			Head.					Mean of readings of weighing apparatus.	Mean of readings of velocimeter.
					High-pressure cylinder.	Low-pressure cylinder.	Total.	Suction head.		Mean delivery head (feet of water).	Mean velocity head by barge (feet of water).	Total mean head (feet of water).		
								Mean head (inches of mercury).	Mean head (feet of water).					
7	Dec. 11, 1894	3.30 p. m.	118	154	166	153	319	9.18	10.40	15.53	2.75	28.68	4.9	11.1
8	Dec. 12, 1894	10.25 a. m.	118	153	165	154	319	9.32	10.56	15.80	1.90	28.26	18.8	11.8
9	Dec. 13, 1894	7.59 a. m.	117	150	165	147	312	9.21	10.44	15.39	2.11	27.94	11.8	11.7
10	...do	3.18 p. m.	116	143	154	137	291	8.65	9.80	15.38	2.11	27.29	7.7	....
11	Dec. 14, 1894	10.20 a. m.	119	155	166	153	319	9.20	10.43	16.59	2.40	29.42	14.4	11
12	Dec. 15, 1894	9.15 a. m.	118	150	164	155	319	8.98	10.18	15.23	2.23	27.64	10.1	13.1
13	Dec. 17, 1894	8.27 a. m.	115	150	166	150	316	9.29	10.53	14.08	2.58	27.19	9.2	11.3
14	Dec. 18, 1894	1.25 p. m.	118	150	163	151	314	8.90	10.09	15.90	2.02	28.01	11.2	11.6
15	Dec. 19, 1894	1.43 p. m.	119	153	167	154	321	9.33	10.57	15.32	2.61	28.50	9.2	11.2
16	Dec. 24, 1894	10.35 a. m.	123	146	159	147	306	7.11	8.06	22.13	1.48	31.67	8.1	11
17	Dec. 26, 1894	12.35 p. m.	127	138	156	138	294	7.62	8.63	22.80	.88	32.31	20.8	12
18	Dec. 27, 1894	10.31 a. m.	130	140	159	140	299	6.42	7.27	22.64	.96	30.87	26.2	....
19	Dec. 29, 1894	10.17 a. m.	130	146	166	152	318	7.16	8.12	24.53	1.32	32.97	15.7	9.8
20	Dec. 31, 1894	11.05 a. m.	125	130	145	129	274	6.44	7.30	25.52	1.24	34.06	23.1	8.3
21	Jan. 1, 1895	9.24 a. m.	129	143	167	151	318	7.17	8.13	23.36	1.39	32.88	13.7	8.8
22	Jan. 2, 1895	9.47 a. m.	120	140	155	145	300	7.68	8.70	20.73	1.80	31.23	12.1	9.4

No. of test.	Date.	Time.	Measuring barge.										
			Area of barge.	Mean depth of water in barge before test.	Mean depth of water in barge at end of test.	Mean depth of water pumped.	Duration of test (seconds).	Material pumped.	Cubic feet per second.	Velocity per second.	Sand pumped.	Percentage of sand.	Capacity of pump (cubic yards per hour).
			Sq. ft.					*Cu. ft.*		*Feet.*	*Cu. ft.*		
7	Dec. 11, 1894	3.30 p. m.	2,544.01	0.626	4.478	3.852	150	9,799.52	65.33	13.31	552	5.63	491
8	Dec. 12, 1894	10.25 a. m.	2,544.01	.707	3.663	2.956	138	7,520.09	54.49	11.10	936.5	12.45	905
9	Dec. 13, 1894	7.59 a. m.	2,544.01	.575	3.340	2.765	122	7,034.18	57.66	11.74	766.5	10.89	838
10	...do	3.18 p. m.	2,544.01	.438	3.610	3.172	140	8,069.60	57.64	11.74	614	7.61	585
11	Dec. 14, 1894	10.20 a. m.	2,544.01	.406	4.120	3.714	155	9,448.45	60.96	12.41	970	10.27	835
12	Dec. 15, 1894	9.15 a. m.	2,544.01	.505	3.713	3.208	138	8,161.18	59.14	12.04	520	6.37	503
13	Dec. 17, 1894	8.27 a. m.	2,544.01	.398	3.450	3.052	123	7,764.31	63.12	12.85	715	9.21	775
14	Dec. 18, 1894	1.25 p. m.	2,544.01	.473	3.465	2.992	135	7,611.67	56.38	11.48	660	8.67	652
15	Dec. 19, 1894	1.43 p. m.	2,544.01	.448	3.720	3.272	131	8,324	63.54	12.94	516.3	6.20	526
16	Dec. 24, 1894	10.35 a. m.	2,544.01	.562	4.018	3.456	183	8,792.09	48.04	9.78	460	5.23	335
17	Dec. 26, 1894	12.35 p. m.	2,544.01	.438	3.260	2.822	194	7,179.19	37.01	7.53	530	7.38	364
18	Dec. 27, 1894	10.31 a. m.	2,544.01	.461	3.448	2.987	197	7,598.95	38.57	7.85	925	12.17	626
19	Dec. 29, 1894	10.17 a. m.	2,544.01	.557	3.647	3.090	174	7,860.99	45.18	9.20	716	9.11	549
20	Dec. 31, 1894	11.05 a. m.	2,544.01	.530	3.857	3.327	193	8,463.92	43.85	8.94	586.6	6.93	405
21	Jan. 1, 1895	9.24 a. m.	2,544.01	.616	3.975	3.359	184	8,545.32	46.44	9.46	663	7.75	446
22	Jan. 2, 1895	9.47 a. m.	2,544.01	.643	4.392	3.749	180	9,537.49	52.98	10.79	849	8.90	629

Average capacity in cubic yards per hour, 547.5; floating pipe, 678.8. Average capacity in cubic yards per hour, 1,002.5; floating pipe, 479.1.

Table of tests of the United States experimental dredge, etc.—Continued.

No. of test.	Date.	Time.	Miscellaneous. Sand. Weight of 1 cubic foot, dry.	Sand. Percentage of volds.	Depth of water at bow. Port.	Depth of water at bow. Starboard.	Flotation of discharge pipes.	Efficiency. Work done, in foot-pounds per second, as measured by barge.	Efficiency. Work done, in foot-pounds per second, as measured by indicator cards.	Efficiency. Per cent.	Remarks.
7	Dec. 11, 1894	3.30 p. m.	106	35	6.5	7.3	O. K.	117,106	175,450	66.75	
8	Dec. 12, 1894	10.25 a. m.	104	33⅓	7	8	O. K.	96,244	175,450	54.85	
9	Dec. 13, 1894	7.59 a. m.	104	38	5.5	6.5	Low.	100,688	171,600	58.67	
10	...do.....	3.18 p. m.	108	36⅔	6	6.5	O. K.	98,312	160,050	61.42	Velocimeter choked with sand.
11	Dec. 14, 1894	10.20 a. m.	104	37½	6.5	7.3	O. K.	112,062	175,450	63.87	
12	Dec. 15, 1894	9.15 a. m.	109	36⅔	6.5	7.5	High.	102,187	175,450	58.24	
13	Dec. 17, 1894	8.27 a. m.	109	33⅓	8.2	8.3	O. K.	107,250	173,800	61.71	
14	Dec. 18, 1894	1.25 p. m.	106	36⅔	7	7.7	O. K.	98,687	172,700	57.14	
15	Dec. 19, 1894	1.43 p. m.	106	38½	8.2	8	High.	113,187	176,550	64.11	
16	Dec. 24, 1894	10.35 a. m.	100	41⅔	10	9.5	Low.	95,062	168,300	56.48	Mud in sand.
17	Dec. 26, 1894	12.35 p. m.	108	38½	5.5	5	Low.	74,750	161,700	46.23	Clay lumps in sand.
18	Dec. 27, 1894	10.31 a. m.	106	36⅔	5.5	8	Low.	74,437	164,450	45.27	Velocimeter choked with sand.
19	Dec. 29, 1894	10.17 a. m.	108	37½	5	5	High.	93,125	174,900	53.25	
20	Dec. 31, 1894	11.05 a. m.	111	34½	7	6.2	O. K.	93,375	150,700	62.62	
21	Jan. 1, 1895	9.24 a. m.	107	40	3.5	4	O. K.	95,438	174,900	54.57	
22	Jan. 2, 1895	9.47 a. m.	103	41⅔	5	5	O. K.	103,438	165,000	62.69	

Abstract of proposals for furnishing brush, poles, wire, wire-strand clips, and manila rope, received in response to advertisement dated June 15, 1894, and opened June 30, 1894, by First Lieut. J. C. Sanford, Corps of Engineers.

No.	Name and address of bidder.	Brush, per cord.	Poles, per cord.	Black steel wire. No. 9, per pound.	Black steel wire. No. 12, per pound.	Galvanized wire strand. ¼-inch, per pound.	Galvanized wire strand. ⅜-inch, per pound.	Galvanized wire strand. ½-inch, per pound.	Silicon bronze wire, per pound.	Wire-rope clips. ⅜-inch, each.	Wire-rope clips. ½-inch, each.	Manila rope, per pound.
1	Wm. C. Frederick, St. Louis, Mo	.....	.....	*Cents.* 1.67½	*Cents.* 1.67½	*Cents.* *2.95	*Cents.* *2.65	*Cents.* *2.74	*Cents.*	*Cents.* *a* 2½	*Cents.* *a* 3½	*Cents.* 7.85
2	Harry E. Coffin, Memphis, Tenn	.....	.....	*1.44	*1.54	3.30	2.87	3.25	*15	*b* 9 *c* 11½	*b* 12½ *c* 14	*7½
3	Lee Bros., Memphis, Tenn.	.....	.....	1.56	1.66	3.87	3.23	3.00	.....	*c* 7.87	*c* 10.39	7.80
4	Livermore, Foundry and Machine Co., Memphis, Tenn	.....	.....	1.54½	1.74½	4.10	3.90	3.90	.....	*c* 9½ *d* 6½	*c* 12	.....
5	Elisha Evins, Memphis, Tenn	$1.14½	$2.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	M. M. Buck & Co., St. Louis, Mo	.....	.....	1.46	1.57	3.30	2.87	3.25	*15	*c* 8.6 *e* 9	*c* 10.1 *c* 12½	.....
7	W. H. Amerland, St. Louis, Mo	.....	.....	1.66	1.66	3.29	2.69	2.79	.....	*c* 7½ *f* 4	*c* 10 *f* 4	7½
8	Hunter & Frey, Memphis, Tenn	*1.07	*1.50	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	Manogue-Pidgeon Iron Co., Memphis, Tenn	.....	.....	1.60	1.60	3.90	3.25	3.02	.....	*c* 7.73	*c* 10½	.....

* Accepted. All bids for wire-rope clips rejected.
a U-bolt clips.
b Magnolia clips.
c Crosby clips.
d Double U clips.
e Wilcox clips.
f S clips.

Abstract of proposals for levee work in upper Yazoo levee district, received in response to advertisement dated September 24, 1894, and opened October 5, 1894, by Capt. S. W. Roessler, Corps of Engineers.

No.	Name and address of bidder.	Section 1–4, per cubic yard.	Section 5–7, per cubic yard.	Section 8–10, per cubic yard.	Section 18–22, per cubic yard.	Moon Lake, per cubic yard.	Or Moon Lake divided.	
							Station 3326 to Station 3355, per cubic yard.	Station 3390 to Station 3429 + 92, per cubic yard.
		Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1	Chas. H. Dameron, Friars Point, Miss.	.....	.....	.....	.....	9.99	.....	.....
2	Timothy Sullivan, Memphis, Tenn.	10.95	*16.95	11½	11.20	12.98	.....	.....
3	McLaughlin Bros., Memphis, Tenn.	10¾	12	11½	12¾	14¼	.....	.....
4	L. C. Dulaney, Mayersville, Miss.	11.74	16	13.99	12.44	.....	.....	.....
5	Hugh McCartin, Memphis, Tenn.	.....	.....	.....	.....	13½	.....	.....
6	W. A. Shipley, Friars Point, Miss.	14	14¾	.....	11	.....	10.75	*8.99
7	Batt. O'Brien, Memphis, Tenn.	13.45	14.25	13.98	15.24	11.23	.....	.....
8	Manning & Gibson, Oakwood, Miss.	14	.....	15	9.98½	12.74	.....	.....
9	T. S. Aderholdt, Friars Point, Miss.	14.40	16.20	11.74	12.74	10.24	*10.40	.....
10	Moore & Welsh, Memphis, Tenn.	10¾	15¾	12¾	*9.98	.....	.....	.....
11	Martin Jennings, Memphis, Tenn.	.....	.....	.....	.....	11¾	.....	.....
12	J. C. McIntyre & Co., Memphis, Tenn.	11¾	14.4	12½	11.48	14	.....	.....
13	Robert Johnsen, Memphis, Tenn.	11.74	15.24	14.49	14.24	16.99	.....	.....
14	John G. Sessions, Leota, Miss.	*10	12⅞	*9.95	11⅞	12.97	.....	.....
15	James K. Jeffries, Memphis, Tenn.	13	13	12¾	14	.....	15	12¾

*Accepted.

Abstract of proposals for levee work in vicinity of Walnut Bend, Arkansas, received in response to advertisement dated September 24, 1894, and opened October 9, 1894, by Capt. S. W. Roessler, Corps of Engineers.

No.	Name and address of bidder.	Station 5676 to Station 5805, per cubic yard.	Station 5805 to Station 5914, per cubic yard.	Station 5914 to Station 5967, per cubic yard.	Station 5967 to Station 5994, per cubic yard.
		Cents.	*Cents.*	*Cents.*	*Cents.*
1	Manning & Gibson, Oakwood, Miss.	.....	10	.....	.....
2	W. A. Shippey, Friars Point, Miss.	15	12	.....	.....
3	McLaughlin Bros., Memphis, Tenn.	17	11½	19.99	22
4	T. H. Rice, Helena, Ark.	.....	*9.94	.....	.....
5	Robert Johnsen, Memphis, Tenn.	*13.49	10.24	*13.24	*16.99
6	Arnold, De Garis & Co., Memphis, Tenn.	14¾	12¾	17¾	17½
7	J. C. McIntyre & Co., Memphis, Tenn.	13¾	10.65	17¾	19¾
8	Jas. K. Jeffries, Memphis, Tenn.	16	13	22½	25
9	Moore & Welsh, Memphis, Tenn.	.....	12.24	.....	.....
10	John G. Sessions, Leota, Miss.	.....	11.23	.....	.....

*Accepted.

Abstract of proposals for levee work in lower St. Francis levee district, received in response to advertisement dated October 24, 1894, and opened November 7, 1894, by Capt. S. W. Roessler, Corps of Engineers.

No.	Name and address of bidder.	Station 422+50 to Station 531, per cubic yard.	Station 531 to Station 644, per cubic yard.	Station 644 to Station 780, per cubic yard.	Station 780 to Station 897+40, per cubic yard.
		Cents.	*Cents.*	*Cents.*	*Cents.*
1	Ferrell & Watkins, Beulah, Miss	.....	13	12	10.96
2	Hugh J. Loonam, Memphis, Tenn	.....	.....	.....	11.40
3	W. M. Forrest, Memphis, Tenn	11½	9	8.74	*8.24
4	Timothy Sullivan, Memphis, Tenn	11¼	9⅛	9.45	9.45
5	Ernest Hyner, Greenville, Miss	13	11	10	10
6	C. A. Winter, Greenville, Miss	18	13.98	10⅝	11⅛
7	Chas. H. Dameron, Friars Point, Miss	14.99	11.99	9	9
8	Ben. Tally, Memphis, Tenn	.....	9.99	9.90	9.90
9	J. F. Kenney, Cairo, Ill	14	11	9⅜	9⅜
10	Jas. K. Jeffries, Memphis, Tenn	17	15	12	11
11	McLaughlin Bros., Memphis, Tenn	11.99	11.43	9.99	9.24
12	Arnold & DeGaris, Memphis, Tenn	14½	12	10⅛	9⅝
13	Johnsen & Outzen, Memphis, Tenn	15.99	12.99	11.20	10.49
14	Batt. O'Brien, Memphis, Tenn	12.98	9.98	8.44	8.73
15	Manning & Gibson, Bayou Goula, La	16½	13	9	8.24
16	Michael McTighe, Memphis, Tenn	14¾	12½	12	10.75
17	John Scott & Sons, St. Louis, Mo	13 3/16	10 3/16	9 1/16	†9 1/16
18	T. Mike, Memphis, Tenn	.....	10.23	.....	8.24
19	J. C. McIntyre & Co., Memphis, Tenn	13⅜	11⅜	10⅜	9⅞
20	James Austin, Barfield, Ark	.....	.....	8.40	.....

* Or 9½ cents per cubic yard for the whole work. Accepted.
† Or 10 cents per cubic yard for the whole work.

Abstract of proposals for levee work in lower St. Francis levee district received in response to advertisement dated November 21, 1894, and opened December 3, 1894, by Capt. S. W. Roessler, Corps of Engineers.

No.	Name and address of bidder.	Station 897+40 southward, per cubic yard.
		Cents.
1	Johnsen & Outzen, Memphis, Tenn	8.33
2	John Scott & Sons, St. Louis, Mo	8.99
3	T. Mike, Memphis, Tenn	*8.19
4	Batt. O'Brien, Memphis, Tenn	9.96
5	J. C. McIntyre & Co., Memphis, Tenn	8 1/16
6	Forrest & Co., Memphis, Tenn	9.23
7	J. C. Hodge, Griffin, La	11.49
8	Timothy Sullivan, Memphis, Tenn	8.42
9	Manning & Gibson, White Castle, La	12
10	McBain & Co., Memphis, Tenn	12⅜

* Accepted.

Abstract of proposals for levee work in upper White River levee district, received in response to advertisement dated December 15, 1894, and opened December 31, 1894, by Capt. S. W. Roessler, Corps of Engineers.

No.	Name and address of bidder.	Station 83+50 westward, per cubic yard.	Station 1392 southward, per cubic yard.
		Cents.	*Cents.*
1	Chas. H. Dameron & Co., Lake Providence, La	12	14½
2	McLaughlin Bros., Memphis, Tenn	9.49	12.74
3	Forrest & Co., Memphis, Tenn	*9½	17½
4	J. C. Hodge, Griffin, La	12½	14.95
5	W. A. Shippey, Friars Point, Miss	9.98	12.99
6	Batt. O'Brien, Memphis, Tenn	11.73	14.73
7	C. A. Winter, Greenville, Miss	.....	16½
8	Timothy Sullivan, Memphis, Tenn	9½	15½
9	T. H. Rice, Helena, Ark	9.70	15
10	Moore & Welsh, Memphis, Tenn	.....	*12⅝
11	T. S. Aderholdt, Friars Point, Miss	10.08	13.74
12	Johnsen & Outzen, Memphis, Tenn	12.24	14.49
13	J. C. McIntyre & Co., Memphis, Tenn	11.18	14.87
14	McBain & Co., Memphis, Tenn	10½	15½
15	W. L. Withers & Co., Memphis, Tenn	.....	14.48

* Accepted.

Abstract of proposals for docking and repairing steamer Minnetonka, received in response to advertisement dated January 10, 1895, and opened January 21, 1895, by First Lieut. Graham D. Fitch, Corps of Engineers.

No.	Name and address of bidder.	Total cost.
1	Thos. P. Morse, St. Louis, Mo	$9,127.00
2	Mississippi Valley Marine Railway and Dock Co., Mound City, Ill	*7,393.25
3	David S. Barmore, Madison, Ind	10,757.10

* Accepted.

Abstract of proposals for furnishing stone for use at Plum Point Reach, received in response to advertisement dated February 25, 1895, and opened March 12, 1895, by Capt. Graham D. Fitch, Corps of Engineers.

No.	Name and address of bidder.	Delivered on Government barges at quarries.			Delivered on contractors' barges at works.			
					Unloaded by contractor.		Unloaded by Government.	
		Large riprap, per cubic yard.	Small riprap, per cubic yard.	Quarry spalls, per cubic yard.	Small riprap, per cubic yard.	Quarry spalls, per cubic yard.	Small riprap, per cubic yard.	Quarry spalls, per cubic yard.
		Cents.	*Cents.*	*Cents.*				
1	C. C. Huthmacher, Murphysboro, Ill	55	.....	.....	.....	.....	.....	.....
2	John Barrett, Cincinnati, Ohio	.....	.....	.....	$1.83	$1.83	$1.65	$1.65
3	John F. Oliver, Neelys Landing, Mo	.....	*50	*40	.....	.....	.....	.....
4	E. E. Burke, Neelys Landing, Mo	*50	58	50	.....	.....	.....	.....
5	Frederick Hartweg, Cincinnati, Ohio	.....	.....	.....	*1.59	*1.84	*1.44	*1.19
6	Ed. Hely, West Plains, Mo	60	60	45	1.59	1.44	1.39	1.24

* Accepted.

Abstract of proposals for levee work in lower White River levee district, received in response to advertisement dated April 19, 1895, and opened May 4, 1895, by Capt. Graham D. Fitch, Corps of Engineers.

No.	Name and address of bidder.	Henrico, Ark., Station 0 to Stations 237 +76 per cubic yard.	Henrico to Laconia, Station 284 to Station 504, per cubic yard.	Station 1456 northward, per cubic yard.
		Cents.	*Cents.*	*Cents.*
1	Hugh J. Loonum, Alpika, Miss	9	.....	.....
2	Ernest Hyner, Greenville, Miss	10.2	11.2	17
3	P. F. Lamb, Stafford, Miss	10½	12⅜	16⅝
4	C. A. Winter, Pettit, Miss	9.47	10.94	14.97
5	Manning & Gibson, Red Fork, Ark	13	16	20
6	Wm. R. Lewis, Greenville, Miss	.....	10.4	13⅜
7	McLaughlin Bros., Memphis, Tenn	10	11	16
8	Ben. Talley, Memphis, Tenn	8.9	11.98	14.95
9	Timothy Sullivan, Memphis, Tenn	8½	11	15
10	W. A. Shippey, Friars Point, Miss	* 8	* 8.44	.....
11	Edwin B. Helgoson, Natchez, Miss	8.95	8.95	14.45
12	J. C. Hodge, Griffin, La	9.8	10.8	* 13½
13	Johnsen & Outzen, Memphis, Tenn	9	11.44	13.49
14	C. F. De Garis, Memphis, Tenn	11	12	17
15	Batt. O'Brien, Memphis, Tenn	9.74	11	14.24
16	T. S. Aderholdt, Friars Point, Miss	9.24	9.74	16.74
17	C. H. Dameron & Bro., Friars Point, Miss	9⅜	10⅛	16
18	Morgan & McCartin, Memphis, Tenn	8.98	9.98	16.24
19	Martin Jennings, Memphis, Tenn	9½	11	18
20	Jas. H. & Michael McTighe, Memphis, Tenn	9.88	11.98	17.75
21	E. B. Mantle, Memphis, Tenn	8.87	.....	.....

* Accepted.

List of civilian engineers employed on work of improving Mississippi River, first and second districts, in charge of Capt. Graham D. Fitch, Corps of Engineers, from June 1, 1894, to May 31, 1895.

Name and residence.	Time employed.	Pay per month.	Where employed.	Work on which employed.
	Months.			
W. M. Rees, Memphis, Tenn	12	$250	Memphis and in the field.	Office and miscellaneous field work.
Aug. J. Nolty, Memphis, Tenn.	12	175	Plum Point Reach and Memphis, Tenn.	Construction to Plum Point Reach and repairs to plant.
C. W. Sturtevant, Appleton, City, Mo.	8⅝	150	Mississippi River	In charge of experimental dredge.
Wm. Gerig, Columbia, Mo	12	150	Various places	Construction, Hickman, Ky., and New Madrid, Mo.; construction and repairs to levee and repairs to and construction of plant.
B. B. Gordon, Greenville, Miss.	10	150	do	Surveys, gauges, and observations.
	2	165	Gold Dust, Tenn., and Stewarts, Mo.	Construction Plum Point Reach, and construction and repairs of levee.
Chas. Le Vasaner, Memphis, Tenn.	3⅜	125	Grand Tower, Ill	Inspecting stone.
	7⅝	150	Various places	Surveys, gauges, and observations.
A. F. Kilpatrick, Memphis, Tenn.	10	125	Barfield, Ark., and Stewarts, Mo.	Construction and repairs of levee.
	2	140		
M. Gardner, Memphis, Tenn	10	125	Austin, and Alpika, Miss.	Do.
	2	140		
A. L. Dabney, Vicksburg, Miss.	10⅞	125	Laconia, Avenue, and Henrico, Ark.	Do.
	⅛	140		
C. H. Purvis, Helena, Ark	10	125	Modoc, Ark.	Do.
	2	140		
Fred Wigstrand, Memphis, Tenn.	6⅛	125	Askew, Ark., and Clarks, Miss.	Do.
	1⅛	115		
O. W. Ferguson, St. Louis, Mo.	1⅛	125	Memphis, Tenn., and Armstrongs, Ark.	Surveys.
Chas. E. Taylor, St. Louis, Mo.	⅛	100	Memphis, Tenn	Office work.

Approximate value of plant belonging to the United States and used upon the improvement of the Mississippi River, first and second districts.

Class of property.	No.	Approximate value May 1, 1895.	Class of property.	No.	Approximate value May 1, 1895.
Steamer Minnetonka	1	$20,000.00	Experimental dredge	1	$49,500.00
Steamer Titan	1	11,500.00	Machine-shop boats	2	5,850.00
Steamer Itasca	1	7,000.00	Floating dock	1	3,628.00
Steamer H. M. Graham	1	4,000.00	Flatboats	4	1,900.00
Steamer H. L. Abbot	1	3,600.00	Skiffs	38	350.00
Pile drivers	4	6,000.00	Storehouse	1	1,800.00
Quarter boats	11	15,000.00	Tools, appliances, and outfit	.....	11,056.00
Barges	67	77,660.00	Office furniture	.....	400.00
Model	10	29,040.00	Surveying instruments	.....	1,500.00
Mooring	4	5,040.00			
Mattress	6	12,800.00	Total	.....	281,411.00
Hydraulic graders	3	14,387.00			

FINANCIAL STATEMENT.

Improving Mississippi River, first and second districts.

June 1, 1894:		
Balance unexpended	$131,330.49	
June 30, 1895:		
Amounts allotted since last statement	2,327,400.00	
Proceeds of Government property	185.10	
Proceeds of material sold by Captain Townsend	2,164.00	
Proceeds of material sold by Captain Willard	149.50	
Amount received by transfer from Capt. Geo. A. Zinn	723.03	
Amount refunded on account of overpayments, etc	228.56	
		$2,462,180.68
June 30, 1895:		
Amount expended from June 1, 1894, to date	946,650.02	
Amount deposited to credit of Treasurer of United States, being proceeds of Government property	185.10	
Amounts transferred to Capt. Geo. A. Zinn	12,614.21	
		959,449.33
July 1, 1894:		
Balance unexpended		1,502,731.35
Outstanding liabilities	18,700.00	
Amount covered by uncompleted contracts	430,960.33	
		449,660.33
Balance available		1,053,071.02

Examinations, surveys, and contingencies of rivers and harbors.

August 17, 1894, to amount allotted	$50.00
November 2, 1894, by amount expended (services)	50.00
Amount that can be profitably expended in fiscal year ending June 30, 1897	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

FIRST AND SECOND DISTRICTS.

Disbursements made under appropriations for improving Mississippi River, from June 1, 1894, to June 30, 1895.

Contracts made with—	For what made.	Disbursements under contracts.	Liabilities under contracts.	Total.
Arnold & De Garis	Levee work	$51,134.31	.....	$51,134.31
John G. Sessions	....do	18,684.32	$21,136.82	39,821.14
Ernest Hyner	....do	80,247.56	.....	80,247.56
McLaughlin Bros	....do	50,622.04	.....	50,622.04
J. B. Lewis & Co	....do	29,963.35	.....	29,963.35
Timothy Sullivan	....do	26,209.46	5,959.19	32,168.65
Forrest & Co	....do	16,825.66	10,000.00	26,825.66
J. S. McTighe & Co	....do	33,888.67	.....	33,888.67
T. S. Aderholdt	....do	4,750.22	.....	4,750.22
C. A. Winter	....do	6,114.33	.....	6,114.33
E. E. Burke	Stone	6,929.35	.....	6,929.35
J. S. McTighe & Co	....do	50,902.21	.....	50,902.21
M. M. Buck & Co	Silicon bronze wire	1,500.00	.....	1,500.00
W. C. Frederick	Wire strand	3,687.17	.....	3,687.17
Harry E. Coffin	Wire rope, etc	5,201.25	.....	5,201.25
David S. Barmore	Model barges	21,300.00	.....	21,300.00
E. J. Howard	....do	15,000.00	.....	15,000.00
Mississippi Valley Marine Railway and Dock Co.	Repairing steamer Minnetonka.	7,449.01	.....	7,449.01
Hunter & Frey	Brush and poles	33,073.61	.....	33,073.61
Lindon W. Bates	Hydraulic dredge	6,649.96	166,125.04	172,775.00
W. A. Shippey	Levee work	.....	27,397.18	27,397.18
W. M. Forrest	....do	.....	46,805.00	46,805.00
T. Mike	....do	.....	19,983.60	19,983.60
Moore & Welsh	....do	.....	48,471.00	48,471.00
J. C. Hodge	.... do	.....	23,982.50	23,982.50
Frederick Hartweg	Stone	.....	53,900.00	53,900.00
John F Oliver	....do	.....	7,200.00	7,200.00
Total		470,132.48	430,960.33	901,092.81

Disbursements made otherwise than under contract.

For what expended.	By public notice and sealed proposals.	In open market.	Liabilities.	Total.
Material and supplies	$24,567.14	$60,683.46	$5,000	$90,250 60
Subsistence	19,455.14	9,584.47	2,000	31,039.61
Services	.....	201,393.65	10,000	211.393.65
Tools, appliances, and outfit	3,344.16	15,936.09	1,000	20,280.25
Miscellaneous	189.23	7,265.97	700	8,155.20
Total	47,555.67	294,863.64	18.700	361,119.31

Disbursements made under appropriation for improving harbor at Memphis, Tenn., from June 1, 1894, to June 30, 1895.

Contracts made with—	For what made.	Disbursements under contracts.
W. C. Frederick	Wire strand	$1,337.91
Hunter & Frey	Brush and poles	5,993.44
Total		7,331.35

Disbursements made otherwise than under contracts.

For what expended.	By public notice and sealed proposals.	In open market.	Total.
Materials and supplies	$14,992.16	$2,091.22	$17,083.38
Subsistence	989.60	261.84	1,250.44
Services	1.50	12,942.38	12,943.88
Tools, appliances, and outfit	29.15	176.89	206.04
Miscellaneous	.....	282.74	282.74
Total	16,011.41	15,755.07	31,766.48

Disbursements made under appropriation for improving harbor at New Madrid, Mo. June 1, 1894, to June 30, 1895.

Contracts made with—	For what made.	Disb ments cont
W. C. Frederick	Wire strand	

Disbursements made otherwise than under contract.

For what expended.	By public notice and sealed proposals.	In open market.	To
Material and supplies	$6,669.70	$5,810.50	$12,
Subsistence	29.08	121.31	
Services		6,251.66	6,
Tools, appliances, and outfit	55.50	12.05	
Miscellaneous		50.66	
Total	6,754.28	12,246.18	19,

Disbursements made under appropriation for improving St. Francis River, Ark., from 1, 1894, to June 30, 1895.

Contracts made with—	For what made.	Disb ments contr
Robert Johnsen	Levee work	$56,
T. H. Rice	do	13,
Total		69,

Disbursements made otherwise than under contract.

For what expended.	By public notice and sealed proposals.	In open market.	To
Subsistence		$544.19	$
Services		4,269.30	4,
Tools, appliances, and outfit	$19.95	22.75	
Miscellaneous	3.25	182.61	
Total	23.20	5,018.85	5,

APPENDIX 6.

REPORT OF CAPT. C. M'D. TOWNSEND, CORPS OF ENGINEERS, UPON OPERATIO THE THIRD DISTRICT.

UNITED STATES ENGINEER OFFICE,
Memphis, Tenn., May 25, 1

COLONEL: I have the honor to submit the following report of operations i third district, improving Mississippi River, for the year ending May 25, 1895:

This district extends from the mouth of White River to Warrenton, Miss., tance of 220 miles. In its improvement banks have been protected from cavi Lake Bolivar Front, Ashbrook Neck, Greenville, Lake Providence Reach, and Point, chutes have been closed, and the low-water width restricted by perm dikes at various localities through Lake Providence Reach, and levees have constructed and enlarged in the Lower Yazoo, Upper Tensas, and Middle Tensas districts.

The operations of the last season have consisted in the extension of the revet at Ashbrook Neck and Greenville, the protection of 4,800 feet of bank above

Providence, repairs to the old revetments at Ashbrook Neck, Greenville, and Louisiana Bend, and in the construction and enlargement of levees.

LAKE BOLIVAR FRONT (417 MILES BELOW CAIRO).

The object of this improvement has been to stop a caving of the bank which was threatening the destruction of a large levee across the end of Lake Bolivar.

In 1888–89 4,250 feet of bank was protected by a revetment of brush and stone described in the Report of the Chief of Engineers for 1889, page 2704. During the fall of 1893 this revetment was repaired by constructing a subaqueous mat 685 feet in length along a portion of the work where the river was showing a tendency to undermine it, and the brush in the upper bank revetment was replaced by a riprap of 10 inches of stone wherever it showed a tendency to decay.

During the past season this revetment has remained in good condition and no repairs have been required. For several years the point of attack of river currents during floods has been gradually moving down the river in this bend, so that this work will hereafter require little attention except at its lower end, where a tendency to cut behind the paving is still to be observed.

ASHBROOK NECK (446 MILES BELOW CAIRO).

Ashbrook Neck is the upper of four "necks" or "points" of land inclosed in the tortuous course of the Mississippi River in the vicinity of Greenville. The object of the improvement at this locality is to prevent the river from cutting through this neck (which has attained a width of but 2,300 feet) and leaving its present channel, with a disturbance of the regimen of the river both above and below it.

The work of revetting this neck was begun during the season 1890–91 and continued during the next two seasons, 8,900 feet of bank being protected. A description of the work done will be found in the reports of the Chief of Engineers for the corresponding years.

The narrow portion of the neck has been held, but caving has continued in the bend both above and below the work.

During the past season advantage was taken of the low stage of the river to extend the riprap of the upper bank to extreme low water; 2,631 cubic yards of stone was expended for the purpose, at a cost of $5,277.34. A pocket mat 200 by 200 feet was sunk in the eddy formed by the caving at the lower end of the work. At its upper end the revetment was extended 1,275 feet to prevent further destruction of the work by caving in that locality.

The character of the revetment differs from that heretofore employed at this place in having an extra layer of brush over the inner 100 feet of mat; the width of the mats was 280 feet; the average cost per linear foot, $30.25.

The average amounts of material expended per linear foot were:

Brush	cords..	4.11
Poles	do....	.79
Stone	cubic yards..	6.76
Cable	pounds..	15.03
Wire	do....	28.35

The work was materially delayed and its cost increased by inclement weather and running ice in the river, which prevented a prompt delivery of material.

A full description of the season's operations will be found in the appended report of Mr. L. L. Gilkey, superintendent of construction, which accompanies the report of Assistant Engineer Arthur Hider, who was in local charge of the work.

GREENVILLE HARBOR (478 MILES BELOW CAIRO).

The object of the improvement at Greenville has been to prevent the caving of the bank at this locality, which was rapidly destroying the city. In 1887, 1888, and 1889 Greenville front was protected by a system of spur dikes. The caving has ceased in front of the town, but has continued in the bend above it. During the flood of 1890 this caving flanked the upper dikes and threatened the destruction of the remainder. In 1891 the work of revetting the bend above the town was commenced and continued during the season of 1892–93, 11,050 feet of revetment being constructed during the two years. The revetting of the bank has been accompanied by a large increase in thalweg depths through this bend in the vicinity of the upper of the remaining city spur dikes exceeding 40 feet. During the high water of 1894 this spur, which had been damaged during the flood of 1890, was undermined and carried away, leaving the lower end of the revetment exposed to attack. Before the river fell there had been a settlement of the subaqueous mat to Station 56, 1,000

feet above the dike, extending over its entire width, which had been sufficient to cause several breaks in the upper bank revetment.

In the river and harbor appropriation bill approved August 18, 1894, $80,000 was appropriated for continuing this improvement. There was also available for the work stone and other material which had been purchased from previous appropriations and allotments, at an estimated cost of $12,500. These amounts were expended in repairs to old work, in extending the revetment at its lower end to a point of no caving, and at its upper end as far as the remaining funds available for this work would admit. Advantage was taken of the extreme low stage of the river to extend the upper bank riprap of stone from a height of about 3 feet above the zero of Greenville gauge to extreme low water at all places on the old work where the mats were exposed.

Wherever rain wash had gullied the upper bank the riprap was relaid and additional spawls added; 4,920 cubic yards of stone was expended for the above purposes, of which 1,380 cubic yards was obtained by stripping the stone from the vicinity of the banks above the upper spur dike. The estimated cost of the repairs was $6,019.67.

From Station 54+92 to within 300 feet of the upper spur a mat 200 feet wide was sunk over the mats which had settled during the previous high water; the upper bank was stripped of stone, regraded, and repaved. This work was extended to Station 76, a distance of 1,308 feet, with subaqueous mats 280 feet wide. The lengths of mats were so adjusted that when sunk they would abut against the intermediate spur dike. At the upper end of the bend the revetment was extended 1,020 feet.

The subaqueous mats differed from those heretofore employed at this locality by containing an additional amount of brush. At the lower end of the revetment an additional layer of brush was laid over the inner 100 feet. In the mats sunk at the upper end of the work the layer of brush extended the entire width of the mat, the brush being held in place by a grillage of poles, making a mat about 2 feet in thickness.

The average amounts of material used per linear foot of bank revetment at Greenville this season have been as follows:

Brush	cords..	3.96
Poles	do....	.65
Stone	cubic yards..	6.66
Cable	pounds..	16.00
Wire	do....	30.63

The average cost per linear foot has been $28.02. The details of construction will be found in the appended report of Mr. L. L. Gilkey, superintendent of construction.

LAKE PROVIDENCE REACH.

This reach extends from Carolina Landing, 517 miles below Cairo, to Island 95, a distance of 35 miles. Before its improvement was undertaken depths of but 4½ feet at low water had been reported on some of the crossings (Report of Mississippi River Commission, 1883, p. 408). Low-water widths were excessive, the channel obstructed by shifting sand bars of great extent, and a considerable amount of water was diverted from the main channel by a number of chutes.

The original project for its improvement comprised the closure of all chutes and confining the water to a single channel, a general contraction of the width of river during low water, and the revetment of caving banks opposite and above works of contraction.

To close chutes and diminish the low-water width of the river permeable dikes were constructed at Duncansby Crossing, Cottonwood, Meyersville, Elton, Baleshead, and Stack Island, and have been fully described in early reports of the Commission. The amounts constructed are shown in a table appended.

Their first effect was very beneficial; a deposit of from 6 to 18 feet was formed behind them the first season, chutes were closed, and the river at low water contracted and confined to a single channel. During the years 1884 and 1885 the least depth on crossings was 11 feet and the average width of the river through the reach at low water was about 2,500 feet.

The early efforts to revet caving banks were unsuccessful. The width given to the subaqueous mats did not exceed 150 feet, and it is considered doubtful if they contained sufficient brush to resist erosion though them. They were rapidly undermined and destroyed, leaving the contraction works exposed to attack. On account of lack of funds for several years and by reason of the proviso of river and harbor bill of August 5, 1886, which prohibited the construction of revetment work, attempts to protect the banks from caving were not resumed until 1889. During the intervening period a rapid increase in the rate of caving in this reach is observable, due probably

to the works of contraction and levee construction which had been undertaken by the Commission.

Dikes on the concave side of bends were flanked and carried away. Where they were constructed in the convex side, by the caving of the opposite bank, the low-water channel was rapidly removed from their sphere of influence. In 1888 the average width of the river at extreme low water had increased to about 3,300 feet, and the least channel depth on bars since 1891 has ranged from 6 to 7 feet.

While the changes in river channel have been great, the abnormal conditions which existed prior to the construction of the works of contraction have not reappeared; the river tends to flow in a single channel during low water, even where the works constructed to confine it to that channel have been destroyed. It results that, though bars form which are obstructions to navigation, the river currents more rapidly cut a channel through them than formerly.

Upon the resumption of revetment work in 1889 it was proposed to protect from caving the banks of Louisiana Bend (520 miles below Cairo). The object of this improvement was to give a greater permanency in direction to river currents throughout the reach. Work was continued during the seasons 1891–92 and 1892–93, the total length of bank protected being 16,559 feet. The further protection of this bend was then suspended to await the results of the Commission's experiments with dredging. Work during the past season has been confined at this locality to riprapping the brush revetment at extreme low water and repairs to breaks which had occurred in the upper bank revetment. These breaks are caused by a lack of stability in the material on which the stone riprap rests. When exposed to water it is soon converted into a mud which will not retain a slope as gentle as 1 on 6. The cost of the repairs was $2,344.28. (See report of Assistant Engineer Hider, in local charge of the work.)

Lake Providence (542 miles below Cairo).—During the past season the work of revetting the bend above Lake Providence has been begun. The primary object of this improvement has been the protection of the levee across the foot of the lake, whose destruction is being threatened by a rapidly caving bank. This caving would also ultimately have destroyed the town of Lake Providence, and the work will form a valuable portion of any project which may hereafter be adopted for the permanent improvement of Lake Providence Reach. Four thousand seven hundred and eighty linear feet of bank was revetted. For a distance of 2,998 feet the form of revetment employed was similar to that used at Greenville. On the remainder of the work authority was obtained to construct fascine mats similar to those described by Capt. S. W. Roessler, Corps of Engineers, in the Report of the Mississippi River Commission for 1894, and used by him in revetting banks in the first district. The woven mats were given a width of 280 feet; the fascine mats, 300 feet. The average amounts of material per linear foot of revetment were as follows:

Material.		Fascine mat.	Woven mat.
Brush	cords..	4.88	3.31
Poles	do....	.20	.49
Stone	cubic yards..	7.30	7.30
Cable	pounds..	28.75	24.47
Weaving wire strand		14.37	.....
Galvanized wire strand	pounds..	6.02	25.38
Bronze wire	do....	3.38	.....

The average cost per linear foot was $30.41. A detailed description of the work will be found in the appended report of Mr. George C. Thomas, superintendent of construction, accompanying the report of Assistant Engineer Arthur Hider.

DELTA POINT AND VICKSBURG HARBOR (599 MILES BELOW CAIRO).

The holding of Delta Point has been an essential feature of all projects for the improvement of Vicksburg Harbor. Its further recession, by causing the river currents to impinge on the opposite bank at a lower locality, would add to the difficulties of maintaining a channel in front of the city of Vicksburg, either by dredging or by the diversion of the Yazoo River. From 1878 to 1884 10,700 feet of revetment was constructed in this bend, which, though of a weaker character than that employed at other places, required little repairs until 1893. The brush, however, in the upper bank revetment had gradually rotted, and there had been a general deepening of the river at the upper end of the work, which threatened ultimately to undermine the subaqueous mats. During the season of 1893–94, wherever the upper bank was exposed to the action of river currents, the brush revetment was replaced by a riprap of 10 inches of stone and mats 300 feet wide, with a total length of 1,120 feet, were sunk at the upper end of the work. No repairs have been required during the past season.

The bank continues, however, to slowly cave in the bend above the work, and its further extension will ultimately be required to prevent its being flanked.

The project for the improvement of Vicksburg Harbor, recommended by the Mississippi River Commission and approved by the Secretary of War in 1887, consisted in dredging a basin in front of the city, to be connected with the river at Kleinston by a canal. This basin was to be inclosed on its north and west sides by an earth dam to be constructed from the material dredged, so as to limit the inflow of water during floods and thus reduce the amount of deposit. Work on this project was continued from year to year as funds were available, until the passage of the river and harbor act approved July 13, 1892. By this act the project for the diversion of the Yazoo River into Centennial Lake was adopted.

As this project was incompatible with the improvement of Vicksburg Harbor in accordance with the plans of the Mississippi River Commission, work on Vicksburg Harbor was suspended. Its further improvement has been transferred to the officer in charge of the improvement of the Yazoo River.

LEVEES, LOWER YAZOO DISTRICT.

This district is situated on the east bank of the Mississippi River and extends from the Bolivar-Coahoma County line, Mississippi, 365 miles below Cairo, to the mouth of the Yazoo River. Levees have been constructed from the upper end of the district to Eagle Lake, a distance by river of 215 miles. The length of the levee line is about 190 miles, and is under the local charge of the Lower Mississippi Levee Board.

The portion of the Yazoo Basin below Eagle Lake is under the local control of the Vicksburg Levee Board, but in this portion of the district the only levee construction has been a few disconnected private levees for the protection of single plantations.

In the upper portion of the Lower Yazoo district the land behind the levees is generally open and under cultivation, while the abandoned land in front is frequently covered with a forest growth. Toward the lower end of the district wooded land becomes more frequent. The future extension of the levee line to the Yazoo River will in general be through dense forests.

The levee line crosses few sloughs, but at a number of localities is near caving banks. The rate of caving in this portion of the river is rapid.

The levees are generally protected from wave wash by forest growth except where near caving banks. They extend through a comparatively populous country, so that the facilities for their care and maintenance are much better than in some of the other districts.

The grade to which its levees have been constructed by the General Government has been 3 feet above the highest flood. The grade adopted by local authorities in 1890 and 1891 was 1 foot above a hypothetical grade which was computed by the local engineer in charge of the district to be the height the flood of 1890 would have attained if there had been no crevasses in the third district.

In 1892 the local grade was changed to 4 feet above the flood of 1891. In 1893 the Government grade was adopted by local authorities for levees above Greenville.

The grade adopted by the Government has in general been higher than the local grade above Greenville. Between Greenville and opposite Lake Providence they are nearly equal; below Lake Providence the local grade is the higher.

The section adopted for levees by local authorities, and generally conformed to in Government construction, has a width of crown of 8 feet, slopes 1 on 3; levees over 12 feet in height are backed by a banquette 20 feet wide, 8 feet below crown of levee, with a rear slope of 1 on 5.

In localities where the levee is exposed to wave wash, and is composed of sandy material, a front slope of 1 on 4 has been employed; if the material is buckshot, the slope generally given is 1 on 3½. Where gentler slopes than 1 on 3 are used, the banquette has usually been omitted.

Banquettes have in some places been given greater widths than 20 feet, and added to levees of less height than 12 feet where the soil was especially treacherous. A width of berm on the river side of 30 feet is prescribed; on the land side, of 80 feet.

In the construction of new levees it is customary to excavate what is termed a muck ditch, 3 feet in front of the center line of the levee, of a depth of 4 feet, width at bottom 4 feet and at top 6 feet. In enlarging old levees the muck ditch is omitted unless trouble has been experienced from sipage.

The most marked deviation from the established form is found in the levee across the end of Lake Bolivar. This levee is about 27 feet in height. It was built with a width of crown of 15 feet and slopes of 1 on 5, on a grillage composed of two layers of brush to prevent settlement. During the flood of 1883 the sipage under it was so great that the local authorities decided to further enlarge it. Its river slope is now 1 on 7.

On January 1, 1894, the levees of this subdistrict contained 18,895,814 cubic yards of material, of which 4,230,781 cubic yards had been put in place by the General Government.

During the past season the allotment of $150,000 for the fiscal year ending June 30, 1895, for the Lower Yazoo district and available balances from preceding allotments have been expended in the construction of new levees at Australia (L 367), Buck Ridge (L 415), Warfield (L 484), Hayes (L 553), Ingomar (L 567), Chotard to Brunswick (L 571), and in the enlargement of 5¼ miles of the existing line from Eutaw to Mounds Landing (L 434).

The new levees were constructed to replace portions of the levee line threatened with destruction by caving banks; their total length is about 9.2 miles.

The General Government has put in place during the year 1,326,255 cubic yards. The yardage in abandoned levees is 638,902. A tabulated statement of the various contracts is appended.

Minor repairs were also made to the levees constructed by the General Government in the preceding fiscal year. These repairs have consisted in cutting weeds, redressing slopes where badly rain-washed, and resodding portions of the line on which the sod had been destroyed from various causes. The cost of the repair work was $1,944.95.

From January 1, 1894, to January 1, 1895, the Lower Mississippi Levee Board has erected 303,827 cubic yards, replacing levees threatened with destruction by caving banks.

The following table shows the yardage necessary to enlarge the levees of this district to the section adopted by local authorities and to the grade adopted by the General Government. In addition thereto, about 600,000 cubic yards of material would be required to extend the levee line from Eagle Lake to the mouth of the Yazoo River.

List of work to be done in the Mississippi levee district, April 30, 1895.

	Cubic yards.
New levees:	
Waxhaw (approximate)	450,000
Buck Ridge	650,000
Hoop at Offutts	70,000
Greenville Levee	266,800
Warfields	61,750
Arcadia	42,000
Albemarle-Chotard	523,280
Homochitto	250,000
Total new levees	2,313,830
Enlargement, above Greenville:	
Banquette, Stations 27–642	246,000
Banquette, Stations 808–1088	169,000
Banquette, Stations 1272–1542	97,200
Banquette, Stations 3400–3881	325,240
Enlargement, Stations 1574–1845	189,000
Enlargement, Stations 1845–2148	300,300
Enlargement, Stations 2148–2672	461,000
Enlargement, Catfish Point Levee	144,000
Enlargement, Stations 3894–3970	58,900
Enlargement, Stations 3970–4270	207,000
Enlargement, Stations 4270–4550	201,600
Enlargement, Stations 4677–4910	27,000
Enlargement, Greenville front	43,200
Total above Greenville	2,469,440
Enlargement, below Greenville:	
Banquette, Stations 780–940	84,000
Banquette, Stations 940–1387	121,650
Enlargement, Stations 3700–3808	43,200
Enlargement, Stations 3984–4073	91,100
Enlargement, Stations 4178–4379	94,470
Enlargement, Stations 4379–4716	134,800
Banquette to Brunswick Levee	72,000
Total enlargement below Greenville	641,220
RECAPITULATION.	
New levees	2,313,830
Enlargement, above Greenville	2,469,440
Enlargement, below Greenville	641,220
Grand total	5,424,490

The length of the levee line, which is not up to standard section, is 61 miles, but all levees have been enlarged to a height at least 2 feet above the highest flood. I am indebted for the above information to Mr. William Starling, chief engineer Lower Mississippi levee district.

Assistant Engineer. J. D. Van Meter has been in local charge of the work done by the Government above Greenville, Assistant Engineer E. C. Tollinger below Greenville.

LEVEES, UPPER TENSAS DISTRICT.

This district extends from the Arkansas River to the boundary line between the States of Arkansas and Louisiana. It is exposed to overflow from floods occurring in either the Arkansas or Mississippi rivers. The Arkansas River has a levee system extending from the vicinity of Pine Bluff, Ark., to Red Fork, Ark. The levees are small, with narrow crowns, steep slopes, and a grade from 1 to 2 feet above recent floods. Protection from the floods of the Mississippi River is afforded by a line of levees extending from Amos Bayou, about 17 miles above Arkansas City, along Cypress Creek to the Mississippi River, thence to the Louisiana State line, of a length on January 1, 1894, of 84.8 miles.

This district is less tuickly settled than the Lower Yazoo district, and the proportion of levees through forest growth is much greater. The levee line is in general distant from caving banks and is rarely exposed to wave-wash, being protected by the woods and undergrowth between it and the channel of the river. It crosses numerous sloughs and bayous and contains a number of the largest levees along the river. Portions of the line are through an uninhabited country, difficult of access in time of floods.

The grade adopted by the General Government is 3 feet above the highest flood. The standard section has a width of crown of 8 feet, slopes 1 on 3; for levees over 12 feet in height a banquette has been generally constructed within 8 feet of the crown, 20 feet wide, with top slope of 1 on 10, back slope of 1 on 4.

Across bayous and sloughs the grade is raised 1 foot, a width of 10 feet is given to the crown, and the slopes are generally 1 on 4. Where a slope of 1 on 4 exists on the land side the banquet has been omitted.

Banquettes constructed prior to 1892 are 10 feet below crown, top slope 1 on 40, rear slope 1 on 3. Banquettes in excess of standard dimensions and on levees of a less height than 12 feet have been built in the vicinity of crevasses where it has been deemed advisable to remove a deposit of sand to obtain a firmer foundation for the main part of the levee. In such cases the banquette is given such dimensions as will contain the waste material. Along Cypress Creek, where the soil is especially adapted to levee construction, banquettes are not added until the levee attains a height of 14 feet.

The muck ditch has been omitted in new levees through fields which have been long under cultivation; through woods a muck ditch has been dug of dimensions similar to that constructed in the Lower Yazoo district. A muck ditch of larger dimensions has been cut through old levees where they have been enlarged. Bermes of 30 feet are left on the river side and of 80 feet on the land side.

The most marked exception to standard section is the levee across Boggy Bayou, which has a height of 32 feet, a width of crown of 20 feet, slopes of 1 on 5. Levees constructed by the General Government on the Arkansas River, when less than 8 feet in height, have a width of crown of 6 feet.

Levees constructed in this district by the Tensas Levee Board of Louisiana have been built to Government standard, except 6 miles of levees built this season along Amos Bayou, where a section with width of crown of 6 feet, slopes 1 on 2 on river side, with grade 3 feet above the flood of 1892, has been adopted. (These levees rarely exceed 6 feet in height.) In the work done by other local boards the form of section and grade have been very variable.

The allotment for this district for the fiscal year ending June 30, 1895, was $300,000. This sum has been expended in extending the levee on Arkansas River from Red Fork a distance of about 4 miles, constructing new levees from Boggy Bayou to Gaines Landing (R. 445–450), at Panther Forest (R. 451–465), Vaucluse (R. 487), Sunyside (R. 491), Mathews Bend (R. 507), Grand Lake to Sterling (R. 511), Sterling to Louisiana line (R. 516), and enlarging levees at Lucca (R. 427) and Grand Lake (R. 508½). The levees enlarged had been originally constructed by the United States. The new levees are to replace levees built by local authorities.

An examination of the old State levees indicates that their original construction was defective; sufficient care was not exercised in removing stumps, logs, and other foreign matter. The earth used for their construction was obtained from barrow pits close to their base, which have become the habitat for crawfish and other animals which have burrowed under them sufficiently to endanger the stability of their foundation.

The allotments for this district have been expended for the past four years as far as practicable in replacing these antebellum levees, and by the close of the next fiscal year they will be eliminated from the levee line.

The levee at Red Fork replaces a portion of the line along Arkansas River, which had been abandoned by local authorities, and has been constructed to diminish the flow of water which during recent floods has passed through the gap between the levee systems of the Arkansas and Mississippi rivers, inundating the country by flanking the levee line along the Mississippi River at Amos Bayou. A further extension of the Red Fork Levee to the foot of Lake Jefferson (a distance from Red Fork of about 12 miles), is proposed from the allotment for the fiscal year ending June 30, 1896.

The Tensas Levee Board during the past season has also extended the Mississippi levee line along Amos Bayou, a distance of about 6 miles to Costello Gin, erecting 144,440 cubic yards. These combined operations of the United States and local authorities will materially reduce the flow through this gap during floods. How much farther it may be necessary to extend these levees to exclude all river water can not be decided until the influence of existing levee construction on flood heights has been more definitely determined.

The total yardage in contracts for the fiscal year ending June 30, 1895, is about 2,300,000 cubic yards. There had been put in place on May 1, 1895, 2,174,629 cubic yards. A tabulated statement of the various contracts is appended.

A careful survey has been made of the levee line from Amos Bayou to the Louisiana line. Upon the completion of the work under contract its contents will be 9,340,917 cubic yards. The line from Red Fork to the foot of Jefferson Lake will contain about 830,000 cubic yards. The yardage in the line from Pine Bluff to Red Fork is unknown to this office.

With the allotment of $294,000 for the fiscal year ending June 30, 1896, for this district, all levees south of Cypress Creek will be brought to a height at least 3 feet above the highest flood.

The construction of levees at Red Fork, Ark., has been under the local charge of Assistant Engineer J. J. Hoopes; of the portion of the line from Amos Bayou to Luna under Assistant Engineer H. St. L. Coppée, and from Luna to the Louisiana State line under Assistant Engineer E. C. Tollinger.

LEVEES, MIDDLE TENSAS DISTRICT.

This district extends from the Louisiana State line to a point opposite Warrenton, Miss. A levee line extends along its entire front of a length of about 87 miles.

The country has the same general characteristics which are found in the Lower Yazoo district; its levees are more accessible than those in the Upper Tensas district, and there are greater facilities for their care and maintenance during floods. The levee line was originally constructed close to the river, and at numerous localities exposed to destruction by caving banks. The greater part of the allotments for this district in recent years has been expended in establishing new lines at a more secure location.

With the completion of the revetment of the bend above Lake Providence, begun this last season, the strenuous efforts to preserve the continuity of the levee line, which have been necessary in previous years, will be no longer required.

The necessity of constructing so many new levees has prevented, prior to this season, the adoption of as strong a section in levees built by the General Government as has been employed in both the Lower Yazoo and Upper Tensas districts. The banquette has been omitted, but wherever excessive seepage has been observed, local authorities have added a banquette which has generally had a width of crown of 15 feet, 10 feet below the crest of the levee, with a land slope of 1 on 3. The levees recently constructed by local authorities have slopes of 1 on 3; some old State levees, however, have a land slope of 1 on 2½. Levees enlarged this season by local authorities have been raised to a grade 4 feet above the highest flood.

The muck ditch, when employed in this district, has generally a width at top of 4 feet; at bottom, of 2 feet; and a depth of 3 feet. The levees are more exposed to wave wash than in either the Upper Tensas or Lower Yazoo districts. Protection from wave wash, except by sodding, is exceptional. A vertical plank revetment detached from the levee has, however, been constructed on a portion of the line.

The yardage contained in the levees in this district at the close of the last fiscal year was about 8,300,000 cubic yards. The amount of yardage which had been erected by the United States was 3,128,408 cubic yards.

The allotment for this subdistrict for the fiscal year ending June 30, 1895, was $165,000. Contracts were entered into for the construction of a new levee at Reids (R 606), and the enlargement of levees at Opossum Point (R 528), Lake Providence (R 542), Point Lookout (R 550), and Wilton to Salem (R 560–565). The yardage contained in contracts is 941,546 cubic yards, of which about 726,000 cubic yards

was in place May 1, 1895. The new levee at Reids is to replace a levee line which i being destroyed by caving banks. A tabulated statement of the contracts i appended.

Local authorities during the year have enlarged levees at Bunches Bend (R 526) Wylys (R 545), Holly Brook (R 517), Salem (R 565), Villa Vista (R 574), Buckhor (R 578), Millikens Bend (R 581), Nebraska (R 592), Willow Slough (R 593), Young Point to Delta (R 593-597), and Towne (R 599).

The cubic yards in these enlargements are 501,657. Upon the completion of levee under contract, the levee line will contain, as determined by a recent survey, 9,357,86 cubic yards. The levee abandoned at Reids is 11,100 feet long and contains 272,25 cubic yards.

The work in this district has been under the local charge of Assistant Engineer W. S. Brown.

GENERAL REMARKS.

Levees.—Prior to the civil war a levee line had been constructed on both sides of the river through the third district. An examination of the remains of old levees shows that, while in certain localities where the levee was used as a roadway a width of crown exceeding 15 feet was employed, the more prevalent section did not have a width of crown of over 4 feet, with steep slopes.

The crevasses which occurred in 1858 and 1859 sufficiently indicate that these dimensions were inadequate. During the war the line was cut in numerous places by the contending forces, and badly damaged by the floods of 1862 and 1865.

After the war efforts were made by local authorities to repair their levee lines, bu the flood of 1882 again overwhelmed the district. The estimated yardage in th various subdistricts in 1882 and 1895 was as follows:

District.	Length, 1895.	Contents, 1882.	Contents 1895.
	Miles.	*Cubic yards.*	*Cubic ya*
Lower Yazoo	190	5,968,726	19,70
Upper Tensas (south of Cypress Creek)	90.8	1,788,304	9,34
Middle Tensas	87.4	3,181,000	9,35

In Pl. VI, fig. 1, is shown a typical section of a levee of the Upper Tensas trict in 1882. The area of the section has been obtained by dividing the conten the levee line in 1882 by the length that then existed, measured in feet. The diagram shows the levee enlarged to the standard section of 1895. The broken dotted line of the diagram gives the section to which levees were enlarged prior the flood of 1890. On the same plate are shown cross-sections of the levees in whi crevasses have occurred during the floods of 1890, 1891, 1892, and 1893, together wi the section to which the line has been reconstructed. The cross-sections of some the larger levees across bayous are also given.

The cross-section given to levees differs materially from that usually adopted fo embankments confining water in reservoirs or canals. The principal cause of th variation arises from the impracticability of finding in an alluvial valley the foun dation impermeable to water, which is the first requisite in locating a dam for a reservoir. Difficulty is also found in obtaining the material for the puddle core prescribed in reservoir construction, and its utility is materially diminished when it can be flanked by water passing through a permeable foundation into the mass of the embankment behind it.

The section which I have termed the standard section has resulted from practical experience with the soils of the Mississippi basins. A slope of 1 on 3 on the river side, when sodded, has been found to resist the action of river currents and mino wave action. In localities fully exposed to the force of waves through long reache of the river, it is necessary to reenforce the sod with some form of revetment. In the incomplete condition in which the levee line has heretofore been in this district it has been customary to use a temporary revetment of sand bags, brush, or boards which was expected to be efficient only during the flood for which it was employed.

A width of crown of 8 feet is convenient for repair work during floods, affordin space for the storage of materials. With a width of crown of 8 feet, and slope steeper than 1 on 3 as the levee increases in height, surfaces of saturation develo through it, on which there is a tendency for the dry portion of the section to slide.

When the levee attains a height of 12 feet in sandy soils, trouble is experience with its base, or foundation. Where the soil is of a better character, a greate height of levee for a given width of base is allowable.

To give increased width to the base, a banquette is added. The same results coul be obtained by giving a gentler slope to the land side of the levee, but these ban *quettes have been* very generally added to levees already constructed where it woul

have been necessary to destroy the old slope. The banquette also can readily be adjusted to any future enlargement which may be required.

The muck ditch is excavated to explore the foundation. While a number of borings could be made which would detect logs and other extraneous matter, such borings would fail to detect crawfish holes and other cavities which might form a channel for water under the levee.

The reports of assistant engineers in local charge of levees form voluminous documents constantly repeating the same subject, and have, therefore, been omitted. Tables have been derived from them and are appended, which will show the details of construction of the levees which have been completed during the year.

The methods employed in levee construction are shown in the following extract from the report of Assistant Engineer H. St. L. Coppée:

BOGGY BAYOU TO GAINES LANDING LEVEE.

* * * * * * *

"The wheel scrapers used were No. 2 pattern of about 11 cubic feet capacity. One snatch and one plow team were used to about four or five scrapers (varying with the haul and material). The plow teams broke the surface on which the levee was built, and cut up the soil in the borrow pits to enable the scrapers to scoop it up with facility. The snatch teams assisted the scraper teams in loading. In many instances four mules, or two teams, were used with each plow.

"Mules were almost exclusively used, but few horses being worked. One driver was employed to each scraper; one driver and one holder to each plow team; one driver and one loader to each snatch team; one dumper to each 10 scrapers, and a foreman to about the same number. In the wheelbarrow work the station men are practically subcontractors and generally move considerably more material in a given time than hired men. The levee was constructed in 3-foot layers with one-eighth shrinkage for scrapers and one-fifth shrinkage for barrow work, in accordance with the specifications issued November 18, 1893.

PANTHER FOREST SHORT LINE.

"The river bank in the bend along the Panther Forest front (see map) has been caving for a number of years, threatening the ultimate destruction of the old levee below Station 1730. In 1893 the shore line had approached very near the levee. A survey was made, with the view of locating a new line far removed from any possible caving for many years; the one adopted as most economical and advantageous was the 'short line,' which crosses the peninsula, as shown on the map, from Station 1730, joining the Bellview Levee at Station 1826. Its construction was begun about May 1, 1894, and completed April 25, 1895.

"The first two sections of this levee, Stations 0 to 54, are in heavy timber, and a large portion of the way on very low ground, the foundation being in an old lake bed, composed to a great extent of hard deposit honeycombed with logs and roots. Borings made at the beginning of the season showed a top strata of clay and buckshot and logs, underlaid by sand at a depth ranging from 11 to 19 feet. The first two sections, averaging in height over 22 feet, were built to a standard section, 8 feet crown, and 20 feet banquette, main slopes 3 to 1, banquette crown slope 10 to 1, and back slope 4 to 1, the upper edge of banquette being 8 feet below grade of crown, which is 3 feet above high water of 1893. Section 3 is of but 13 feet average height, located in the open field, and constructed to the standard section without banquet (crown 8 feet, slopes 3 to 1, 3 feet above high water of 1893).

"It was at first contemplated excavating the material from the base of the levee to a depth of 3 feet through the lowest portions of the lake and placing it in a banquette. But this purpose was abandoned and the bank made on the natural surface after careful grubbing out of all stumps and logs. This grubbing was extremely heavy and practically equivalent to removal of the material to a depth of 3 feet. The shrinkage required was also in accordance with the old specifications of November 18, 1893, one-eighth for scraper work in 3 feet layers, and one-fifth for wheelbarrow work placed loose, the contractor being required to form steps at the end of each unfinished station during progress of work, to insure better bond of material.

"Care was taken in tamping the material about the center and banquette stakes, and every precaution exercised in the entire construction. During the progress of construction the levee on sections 1 and 2 sank, the grade line or crown going down slowly until on its completion it had reached an average elevation approximating the net grade. This sinking was determined by having crow's-feet attached to center and banquette poles (thus causing them to sink with the ground) and running a level on them from permanent bench marks.

"The shrinkage due to the settling together of the loose particles of material composing the bank was slight, the greatest subsidence being less than a foot. The sinking was caused not only by the *compression of* the natural material in the foun-

dation, but also through the impossibility to thoroughly tamp the material in the deep stump holes so that it would withstand the pressure of the superincumbent levee. Also, by means of the powder exploded in grubbing, the material in the subsoil became very heterogeneous, being compressed at some points and loosened at others, thus forming a foundation unreliable until more thoroughly solidified by the weight of the levee.

"The process employed in grubbing was to take out all lighter roots, trees, etc., with ax and mattock, the heavier timber, after digging a girdling trench to expose roots, having a hole bored under the root with a 2-inch auger from 7 to 15 feet long (the depth of the hole varying with the size of the stump), in which a small charge of dynamite was exploded, thus forming a chamber in which was placed Judson powder and dynamite, the charge depending on the size of tree. In a few instances three separate holes were bored under one stump, but it was impossible to get the charges to explode simultaneously. The following is the size of charge used, dimensions of stump, and yardage of stump hole on a few of the larger trees taken out:

Stations.	Diameter of stump.	Charge of explosive powder.			Stump hole.
		Dynamite.	Judson.	Total.	
	Feet.	*Pounds.*	*Pounds.*	*Pounds.*	*Cub. yds.*
12 to 13	12	100	220	320	641
12 to 13	8	112½	200	312½	533
12 to 13	8	75	200	275	364
28	6	.....	330	330	292
29	6	.....	337	337	163

"The larger débris was removed by ox teams to the land side of the levee, all the small pieces being carried away by hand. The material in stump holes in this levee aggregated over 50,000 cubic yards.

"This levee was constructed in a manner similar to that employed at the Boggy Bayou to Gaines Landing levee, but with far greater difficulty, owing to the excessive heights at many points and the bad weather accompanying the winter season. The muck ditch in the lake bed was 6 feet wide at top, 4 feet wide at bottom, and 6 feet deep, containing 111 cubic yards per station. At other points the ditch was 5 feet at top, 3 feet at bottom, and 4½ feet deep, containing 66¾ cubic yards per station. By means of the ditch great numbers of buried logs were discovered in the subsoil and removed. The ditch was carefully filled with strong material, being tamped with horses. The poorer top material from borrow pits was placed in the banquette, the body of the levee being constructed with that containing no perishable material.

"An examination of the details of construction shows that on this work the conditions as explained were very different on sections 1 and 2 from those existing on section 3. Nearly the entire work of the latter was completed during the summer and fall, when the weather was good; the levee was small, with no banquette, and in the open field; the material light, and haul short; little or no grubbing was necessary and no muck ditch used except at the extreme lower end through a light skirt of woods, which the reverse was the case on sections 1 and 2.

"On the first two sections approximately 30,000 pounds of dynamite and Judson powder were used, or about 15 tons of explosives. The average number of pounds per tree varied on each station with the difference in percentage of large and small stumps, from 7 to 107. The men grubbing moved on an average one-half a tree per man per day.

"The cubic yards of material moved per scraper per day varied from 15 to 64, the former amount being put up during very bad wet weather in the spring (of 1895), and the latter in the fall (1894) when the weather conditions were extremely favorable. The work of the section men was comparatively light, owing to the great dimensions of the levee, but it will be noticed that it was also affected by the weather conditions. White station men, such as are obtained in this vicinity, as a rule move more material with a wheelbarrow than the negro resident. With mixed labor the table gives the average day's work from 10¼ yards in bad weather to 16 in good, while that performed by the colored man was but 9 yards. On section 3 explosives were used on but two stations (69 and 70), 50 pounds, an average of 25 pounds per tree. The men grubbing moved an average of three-fourths of a tree per day.

"During good weather in the summer and fall of 1894 the yards moved per scraper per day on this section varied from 43 to 77, or an average of about 60 cubic yards, in sandy loam; haul, 150 feet. The last few stations of this section and the spur and enlargement were put up with a reduced force in very bad weather, consequently the yardage per scraper per day was reduced more than one-half."

Revetment construction.—In the appended report of Assistant Engineer Arthur Hider is given a tabulated statement of all bank protection which has been con-

structed since 1887. The apparent discrepancy in that statement between the total length of mats, and the length of bank line protected arises from the necessity to lap the mats so as to insure a continuity of covered surface, and from the fact that around projecting points a line measured on top of the bank varies materially from the length along the middle of the mat. In addition to the 10 miles of revetment contained in the table, there exists about 1 mile of revetment at Delta Point constructed prior to the organization of the Mississippi River Commission.

Bank protection constructed prior to 1887, except at Delta Point, was very generally destroyed by the first flood to which it was exposed. The form of construction employed was a continuous subaqueous mat of a width not exceeding 150 feet and an upper bank protection of brush weighted with stone.

In 1887 the experiment was made of protecting the front of Greenville with a system of spur dikes. Of the 6,206 feet of bank thus protected from 1887 to 1889 2,500 feet remain. The cause of the loss of this form of revetment has been the action of river currents during floods on the exposed bank above and behind the dikes, cutting a hole, into which the dike settled, and leaving the next one below it exposed to a similar attack.

In 1889 the form of bank protection with a continuous revetment was again adopted, but the mats were given much greater width and thickness. In the Report of the Chief of Engineers for 1893, page 3752, the amounts of material per linear foot in the different revetments constructed to that date in the Third district were tabulated. The increased strength given to mats noted in that report has been continued in the work of the past season. The following table will show the changes which have taken place since 1884:

Amounts of material in revetment per running foot.

	Delta Point, 1884.	Ashbrook Neck, 1889.	Greenville, 1892.	Lake Providence fascine mat, 1895.
Width of mat.....feet..	144	250	300	300
Brush.....cords..	.6	2.26	2.55	4.88
Poles.....do....	.1	.39	.35	.20
Stone.....cubic yards..	.6	2.39	5.74	7.30
Wire.....pounds..	1.7	30.4	20.98	25.38
Cable.....do....	.....	5.8	14.92	25.54
Iron rods.....do....	.....	12.2	.....	.....

The increase in thickness which has been given the subaqueous mat to prevent erosion through it has necessitated a change in the method of mat construction. The old woven mat, when an extra layer of brush is added, becomes too stiff to adjust itself to irregularities on the bottom of the river. At localities where the soil is a light sand soundings show a tendency of the old woven mat to settle, indicating a passage of the sand through the mat. The fascine mat becomes necessary in such cases to insure permanency to the bank. The only objection to its employment at all localities has been its increased cost, which is about 10 per cent greater than that of the woven mat employed in 1892, notwithstanding the reduction in price of material which has occurred during the interval.

Soundings taken over the various revetments during the past season would indicate that the deepening noted in preceding years at the outer edge of the mat had very generally diminished. This may be due to the fact that the river had not attained a very high stage during the year. Little damage has been done to any of the work during the past season except at Louisiana Bend, where the same tendency of the upper bank to slide as the river falls is found that has been reported during the last two years. The prevention of this sloughing would necessitate the construction of a retaining wall at an expense greater than the present value of the work would justify.

If the revetment can be held by minor repairs for a few years it will be protected from the river by a sand bar which is rapidly extending down the river along this front.

Bank revetment in the third district has not been constructed of sufficient lengths in continuous reaches to determine its value in improving the low-water navigation of the river, but it has fulfilled the special objects for which it has been constructed, viz: At Ashbrook Neck, to prevent a cut-off; at Lake Bolivar and Lake Providence, to protect from destruction large levees; at Greenville, to preserve the city. At Delta Point it has given a fixed direction to the river currents and prevented the further extension of the bar in front of Vicksburg.

Except at Delta Point, the banks protected have been the severest test on revetment construction that could have been selected in the district. At Ashbrook Neck,

Greenville, and Lake Providence the soil was a very fine sand, readily disturbed by water. At Louisiana Bend the bank was largely formed of the unstable silty deposit that is found on the bottom of lakes and bayous. At Lake Bolivar the bank tends to slide out in large masses when exposed to erosive action.

The ease with which the banks could cave had prevented the river from acquiring its normal depth. When this caving was artificially restrained the river increased in depth, undermining the outer edge of the subaqueous mats. Mats constructed since 1889 have adjusted themselves to these changed conditions. Some trouble is experienced in keeping the upper bank revetment of stone in good condition. It has ample strength to protect the soil from river currents, but during low water, when the riprap is exposed, excessive rain storms form streams flowing over the bank which tend to undermine the stone, or by saturating the soil produce a lateral pressure it is unable to resist.

The damage from these causes has not been excessive, and its correction falls under the head of the minor repairs which are required on all structures.

SURVEYS.

Low-water surveys have been made of Greenville Harbor and Lake Providence Reach. Comparative soundings have been taken over the different revetment works, and low-water discharge observations taken at Wilsons Point, La., and below Greenville, Miss. The levee lines in the Upper and Middle Tensas districts have been surveyed and marked by a series of iron bench marks placed at distances of 1,000 feet, and numerous detailed surveys have been made for the purpose of levee location. A detailed report of the operations of the survey party will be found in the appended report of Assistant Engineer Arthur Hider.

CARE OF AND REPAIRS TO PLANT.

On the night of July 1, 1894, the fleet was struck by a cyclone which broke from their moorings all the floating property with the exception of the headquarter boat and a small quarter boat used by the survey party, and scattered them on sand bars along the river for a distance of 30 miles.

The principal loss was confined to vessels which were of little value and had been recommended for condemnation, but the amount of repairs required this season has been increased from this cause. A detailed estimate of the cost of repairs to the different vessels is appended. A financial statement accompanies this report.

Very respectfully, your obedient servant,

C. McD. TOWNSEND,
Captain, Corps of Engineers.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.,
President Mississippi River Commission.

APPENDIX 6 A.

REPORT OF ASSISTANT ENGINEER ARTHUR HIDER UPON REVETMENT CONSTRUCTION, CARE OF PLANT, AND SURVEYS.

GREENVILLE, MISS., *May 1, 1895.*

SIR: The following report from May 1, 1894, to May 1, 1895, of the revetment construction, repairs to plant, and surveys under my charge in the third district is respectfully submitted:

REVETMENTS.

LAKE BOLIVAR FRONT (L. 417–418).

Length, 3,850 feet; in good condition. This work was built in 1888. The channel of the river at this locality has changed so that this revetment has no longer to withstand the direct force of the current at high water and no further work will probably be needed. No construction work was done during the present season.

ASHBROOK NECK (L. 444–447).

Length, 10,310 feet; in good condition. This revetment has been extended at its upper end the present season a distance of 1,309 feet, and a mat 200 by 200 feet put in at the lower end of the old work to protect it from eddy action caused by the *caving back* of the unprotected bank immediately below.

Repairs were made to the old revetment at the low-water line by putting on additional stone where needed, the extremely low stage of water the present season being unusually favorable for doing this work. The entire revetment is in a very satisfactory shape, as shown by the survey of March, 1895.

To complete the improvement of this bend it is considered desirable that this revetment should be extended at its upper end about 2,000 feet farther upstream.

GREENVILLE HARBOR (L. 476–479).

Length, 12,475 feet; in good condition; 2,067 feet of revetment was put in at the lower end of the revetment built in 1891 and below where the continuous mats terminated.

This work was in the nature of repairs rendered necessary by the caving of the revetment of 1891, due to obstructions caused by old dikes built in 1887. These dikes having been flanked, the main current of the river was concentrated in a channel about 500 feet wide between them and the shore, causing an unusual scour and undermining the revetment.

The revetment has been extended 1,020 feet at the upper end. Repairs were made by adding additional stone to the lower part of the slope near the low-water line along the entire length of the old revetment where necessary.

LOUISIANA BEND (R. 521½–524½).

Length, 16,300 feet; in fair condition. No new work was done. Repairs were made at several places along the lower part of this revetment where sloughing of the bank had taken place. Along this part of the revetment, built in 1891–92, a careful comparison of the survey of September, 1893, with that of December, 1894, shows that from Stations 61 to 92, a distance of 3,000 feet, there has been an average fill along the outer edge of the mat of 6.1 feet, while over the mat itself the deposit was 3.6; below this to the end of the revetment (Stations 92 to 168, 7,600 feet) the survey of December, 1894, compared with that of December, 1892, shows an average scour and deepening of the channel along the outer edge of 14 feet. The scour extends under the mat about one-half the distance to shore; from this point to the inner edge of the revetment the fill over the mat averages 8 feet.

Repairs.—After the water in the river had reached a low stage a careful examination of this revetment showed that longitudinal cracks had developed in the upper slope at several places, indicating that there had been a sloughing of the upper bank under water. Careful soundings were made at these points and it was found that such was the case.

The material of which this bank is composed is silt that has been slowly deposited in the bed of an old lake. This material is kept in a state of semisaturation, due to the percolation and drainage of water into the river from a slough connecting with the old lake bed. This slough is only about 600 feet from the river bank. With a bank consisting of material of this character a result similar to this would be expected as the river falls to low stages, as the support which the water at a higher stage gives to the bank is then withdrawn.

In all the pockets where there was an indication of a pushing or sloughing out of the slope the mat was found covered in some places with mud, showing that the bank had slipped bodily over the inner edge of the mattress; the inner edge in one or two instances was found doubled up near the shore. A method to prevent a recurrence of this trouble does not present itself, as it is impracticable to drain the lake and thus remove the cause.

The repairs made consisted in placing additional stone along the lower edge of the slope which was exposed during the unusual low-water stages reached during the season, resurfacing the slope where broken, and replacing the riprap. These repairs were begun November 26 and finished December 23.

The cost is itemized as follows:

1,114 cubic yards stone, at $1.15½	$1,284.81
531⅛ days' labor loading stone on barges, grading and paving bank, at $1.25	664.28
Foremen's wages	77.50
Pay and subsistence of steamboat crew	269.79
Fuel for steamboat	44.08
Supplies for steamboat	3.82
Total cost of repairs	2,344.28

LAKE PROVIDENCE (R. 541–542).

Length, 4,780 feet; in good condition. This work was completed the present season. The revetment was constructed in front of a rapidly caving bank and in an unusually swift current.

An increased quantity of stone has been used on the mats this season, about 1¼ cubic yards to each 100 square feet of surface, sufficient to cover the entire mat to a depth of about 4 inches, the thickness of the slope paving being correspondingly reduced. The quantity of stone per linear foot of completed work is somewhat in excess of that used heretofore.

This change is believed to be desirable, as from experience it has been found that a layer of small stone or spalls from 4 to 6 inches thick is sufficient to prevent erosion and wave wash on the upper slope. The stone saved by reducing thickness of the upper slope paving can be distributed over the subaqueous mats and used to advantage. Small stone on the upper bank slope has proved much preferable to stone of larger dimensions heretofore used.

Spawls on slopes where the material is sand give better results than the ordinary-sized riprap, for the reason that it compacts and settles itself into a solid mass after a few heavy rains; the interstices between the stones being smaller are filled by material washed down from the bank above. The paving is thus protected both from the action of the current and the effect of rain water running down the flat slope and undermining the stone revetment while the work is new and most susceptible of damage from this cause.

A great deal of trouble from rain wash is always experienced on new work before it has been covered by a rise in the river and the interstices between the stones forming the riprap filled in with sediment; especially is this the case when the bank is composed of fine sand, which formation is of frequent occurrence. Heavy rains cause gullies in the upper part of the slope that is left unpaved, and the water flows down these gullies, percolating between and under the stones forming the pavement, undermining it and frequently forming wide and deep washes in the completed riprap. This difficulty has been to a great extent overcome by digging drains to intercept the surface water on top of the bank and lead it down the revetment at intervals in closely paved channels or drains prepared for this purpose.

Fascine mats.—The new style of fascine mats is believed to be a decided advance in the method of mattress construction over the older forms. Among its advantages are:

(1) Greater thickness of mat and compactness of the material of which they are composed.

(2) Greater pliability and strength.

(3) Simplicity of construction.

The closeness with which the fascines are bound together allows the mat to be constructed much more compactly and of greater thickness than the woven mat, and at the same time still retain its pliability and adaptability to adjust itself without tearing or breaking to any irregularities that may exist on the river bottom. Its simplicity of construction requires but little skilled labor, while it can be made more rapidly than the older form. These are all elements that make its superiority over the older form of woven mat apparent.

The quantity of material is somewhat greater, as well as the labor cost, in this form of mat, but it is believed that this is more than compensated for by the advantages above stated, the mats on account of their greater compactness and thickness forming a better protection against scour than those of the old style, and with an abundant supply of material they can be built more rapidly.

At Ashbrook Neck woven mats were built of the old form, the inner 100 feet next the bank being reinforced with an additional layer of brush. At Greenville Harbor the same method was pursued, except that on three of the mats the extra layer of brush extended over the entire mat. At Lake Providence the mats were built similar to those at Ashbrook Neck and Greenville Harbor except three, which were constructed of fascines.

The method of giving the mat additional thickness by covering it with a second layer of brush reduces its pliability and makes it less suited to adjust itself to the irregularities of the bottom when sunk in place than a mat built of fascines.

The following tabulated statement shows the length and locality of revetment work constructed in the third district since 1886:

Length and locality of revetment work, third district.

	Lake Bolivar front.	Ashbrook Neck.	Louisiana Bend.	Greenville Harbor.	Lake Providence.	Delta Point.
Linear feet of mattress built:						
1887-88				* 5,000		
1888-89	4,400			*† 1,136 * 706		
1889-90	†‡ 250		6,024	* 500		
1890-91		2,820				
1891-92		4,460	5,224	6,600		
1892-93		2,610	5,835	4,450		
1893-94	† 685					† 1,120
1894-95		1,309 † 200		1,020 † 2,067	4,803	
Total built	4,400	11,199	17,083	12,776	4,803	
Repairs	685	200		3,203		1,120
Total in good order, length measured on base line	3,850	10,310	16,300	12,475	4,780	840

* Dikes. † Repairs. ‡ Lost.

NOTE.—In addition to the above 2,500 linear feet in front of Greenville is protected by spur dikes.

Mattress built since 1886, total in good condition, 9.19 miles	48,555
To this is to be added that built at Delta Point, 1882-1885, and now in good condition	4,360
Total 10.02 miles	52,915

The cost in detail of the work done at Ashbrook Neck, Greenville Harbor, and Lake Providence the present season is given in the reports of Mr. L. L. Gilkey and George C. Thomas, superintendents of construction, both of whom have rendered commendable and efficient service and shown more than ordinary ability in the conduct of their respective works.

A comparison is given below of the labor cost per unit, the quantity of material used, and average cost per linear foot of the completed works at Ashbrook Neck, Greenville Harbor, and Lake Providence constructed in 1894-95:

Comparative cost per unit for labor.

Kind of work.	Ashbrook Neck.	Greenville Harbor.	Lake Providence.
Mat work, woven, 100 square feet	$1.249	$1.290	$1.824
Mat work, fascine, do			2.171
Grading, hydraulic, 100 linear feet	1.736	2.308	1.228
Grading, hand, do		3.921	.629
Paving slope, 100 square feet	1.682	1.102	.863
Loading stone, cubic yards			.216

Comparative quantities of material used.

Description.	Ashbrook Neck.	Greenville Harbor.	Lake Providence.
Brush per square woven mat, cords	1.163	1.157	0.98
Brush per square fascine mat, do			1.37
Poles per square woven mat, do	.214	.200	.14
Stone per linear foot, yards	6.76	6.66	7.30
Wire per linear foot, pounds	28.35	30.63	25.38
Wire strand per linear foot, do	15.03	16.00	25.54
Spikes	4.47	3.20	1.39

Comparison per cent of cost of labor to cost of material.

	Ashbrook Neck.	Greenville Harbor.	Lake. Providence.
	Per cent.	*Per cent.*	*Per cent.*
Labor	45.3	36.3	46.6
Material	54.7	63.7	53.4
Cost per linear foot	$30.25	$28.22	$30.41

The average cost of these works is, labor, 42.7 per cent; material, 57.3 per cent.

The average cost per linear foot of revetment built during the season was $29.33; the cost of similar work built in 1892-93, $28, an increase in cost over the work of 1892-93 of $1.33 per linear foot. About 50 per cent more brush was used in the mats and 14 per cent more stone than in 1892-93; this, with the interruptions to the work at Ashbrook Neck and Lake Providence, near the close of the season, by floating ice and cold weather, explains the increase in cost.

SURVEYS.

Low-water surveys have been made of Greenville and Lake Providence reaches, comparative soundings over the different revetment works, and low-water discharge observations taken at Wilsons Point, La., and below Greenville, Miss. The force when in the field has been from six to eighteen men and in the office from three to five men.

These surveys have been made under Mr. Charles H. Miller, chief of party, with Mr. P. L. Lowe, Mr. L. L. Griffith, and Mr. Stevenson Archer, jr., as assistants in office and field. The expense of the party was as follows, not including cost of drawing material and instruments:

Salaries, officers, laborers, etc	$7,028.01
Subsistence	1,187.41
Fuel for steamer, 1,800 barrels coal	387.00
Oil	18.75
Total	8,621.17

The work done during the year by this party is given below:

FIELD WORK.

Greenville Reach, 473-489 miles below Cairo; 16 miles of river (low-water survey).

October 25 to November 13:

Ranges across river sounded	50
Located soundings	1,085
Triangulation stations occupied	19
Angles read	27
Miles shore line located by stadia	12
Miles levee line located by stadia	21
Miles bar line located by stadia	4¼

Lake Providence Reach, 517-549; 32 miles river (low-water survey).

September 13 to October 24:

Ranges across river sounded	92
Located soundings	2,690
Triangulation stations occupied	32
Angles read	33
Miles shore line located by stadia	26¾
Miles levee line located by stadia	7¾
Miles bar line located by stadia	31

Ashbrook Neck (L 444-447).

June 25 to 28, 1894:

Ranges sounded	60
Located soundings	720

March 5 to 9, 1895:

Ranges sounded	73
Located soundings	829

Greenville Harbor (L 476-479).

July 11 and 12, 1894:

Ranges sounded over broken revetment	21

December 23, 1894, to January 2, 1895:

Ranges sounded	122
Located soundings	1,464

Louisiana Bend (R 521¼-524¼).

November 26 to December 8:

Ranges sounded	56
Located soundings	708

Lake Providence (R 541-542).

October:

Ranges sounded over space to be covered by revetment base line established	37

Delta Point (R 599).

August 15 to 25:

Ranges sounded	44
Located soundings	528
Miles shore line located by stadia	2
Miles levee line located by stadia	2
Miles levee line established	3

These surveys were made for the purpose of comparing the condition of revetments from year to year. The ranges on which the soundings were taken are marked by stakes on an established base line and the ranges laid out at right angles to this base line. All soundings were located by transit, the profile of upper slope obtained by levelling, and the soundings taken with a 20-pound lead on a one-half inch cotton line tested at frequent intervals. Great care has been taken in these surveys to get accurate results to determine changes in the revetment due to scour.

DISCHARGE MEASUREMENTS.

Two low-water discharges were obtained at Wilsons Point and one at Warfield. Point, about 3 miles below Greenville.

Locality.	Date	Discharge (cubic feet per second).	Mean velocity (feet per second).	Gauge.
Wilsons Point	Sept 26, 1894	175,055	3.99	*2.32
Do	Sept. 27, 1894	177,371	3.95	*2.31
Three miles below Greenville	Nov. 20, 1894	103,771	2.86	†—0.6

*Wilson Point. †Greenville.

The lowest point reached on the Greenville gauge was on November 6, —1.15.

The following shows the amount of caving during the year through the Greenville and Lake Providence reaches, over which low-water surveys were made:

Locality.	Length of caving.	Maximum depth.	Mean depth approximate.
Greenville Reach:	*Feet.*	*Feet.*	*Feet.*
Bachelors Bend	18,000	250	85
Bachelors Towhead	7,000	150	38
Warfield Point	12,000	170	50
Towhead above Leland	5,500	160	55
Walkers Bend	9,000	90	45
Total	51,500	.....	*55
Lake Providence Reach:			
Island 89	7,500	180	112
Sarahs Island	7,500	220	125
Louisiana Bend	6,500	660	218
Island 92	18,000	350	126
Skipwith Towhead	10,000	200	81
Wilsons Point to Cottonwood Point	9,000	130	56
Homochitto	13,500	450	121
Above Lake Providence	18,000	400	145
Shipland	13,000	500	248
Above Point Lookout	16,500	330	206
Total	119,500	.....	*144

*Mean depth.

These surveys show, with but few exceptions, that the caving has been less compared with previous years. In Bachelors Bend, above Greenville, the caving is somewhat greater, and extends for a distance of 3.4 miles above the revetment. To render the improvement in the bend above Greenville secure in future the revetment should be extended at the upper end.

Considerable caving has taken place at Warfield Point, due to change in the low-water channel. This change has moved the crossing to Vaucluse, higher up, and slight caving has taken place.

At Louisiana Bend caving has been active below the revetment, which has resulted in straightening out the bank at the lower end of the bend. Along the

front of Skipwith Towhead the river has encroached so as to form a point below the mouth of the chute. This will increase the eddy action at high water, rendering the old location of the discharge section undesirable for further observations. The best location for a new discharge range now is just below Homochitto, near enough to the old range not to impair the value of results for future comparison.

In the bend above Lake Providence the tendency of the water is now to leave the right bank. The caving during the season has extended for a distance of about a mile above the revetment finished this season. Caving has been less than during previous years, and, with the tendency of the river to leave this bend, it is quite probable that the changes in channel will render unnecessary a much further extension of this revetment.

SUMMARY OF WORK DONE.

Field work:	
Ranges sounded	750
Soundings located	10,618
Miles of line located by stadia	111¼
Triangulation stations set up and repaired	51
Triangulation angles observed	60
Discharge measurements made	3
Miles of base line established for revetment at Lake Providence	1½
Office work:	
Maps made from surveys	10
Tracings	25
Blue prints	235
Progress maps	4
Field sheets	11
Sections plotted	530
Section areas computed	163
Triangles computed	24

REPAIRS TO PLANT.

Below is given in detail the expenditures made in repairs and construction of new plant during the twelve months:

Repairs	$34,745.22
Construction (two new fascine mat boats)	8,678.18
Total	43,423.40

This statement includes cost of material, labor, and subsistence of employees. The average force employed was: Mechanics, 31; laborers, 6.

It will soon be necessary to replace the steamboats now in service with new boats. They are all from ten to twelve years of age, and are rapidly approaching the limit when economical repairs can no longer be made. One new towboat should be built, so as to be available for service the coming low-water season. It is recommended that this boat be of somewhat larger dimensions and of greater power than any now in use in this district, and be built with iron cylinder bearings and boiler beams, steel boilers, and machinery, with latest improvements.

Statement of repairs to plant, third district, improving Mississippi River, May 1, 1894, to April 30, 1895.

Number or name.	Cost.	Remarks.
Steamer Emma Etheridge	$5,152.79	Docked; sides and stern replanked; new frames and floor beams where necessary; new deck except under boiler; extra set of chain braces put in; new steam head, stern post, and necessary repairs during season.
Steamer Osceola	1,364.15	New wheel; general repairs to boat and machinery during season; hull and cabin painted.
Steamer Vidalia	2,855.85	Docked; new cylinder timbers, outriggers, and stern bulkhead; defective plank in hull renewed, broken shaft welded, new pillow block, new wheel, cylinder repaired, machinery thoroughly overhauled, and necessary repairs during season.
Steamer Vedette	839.01	New wheel, rudder stock, and stern bulkhead; shaft straightened, machinery overhauled, and necessary repairs during season.
Steamer Meter	229.87	Ordinary repairs to boat and machinery during the season.
Tug Parker	424.09	Do.

Statement of repairs to plant, third district, improving Mississippi River, etc.—Continued.

Number or name.	Cost.	Remarks.
Quarter boat No. 16	$610.00	Docked; new gunwales, streamers, head blocks, rake pieces, bottom plank, and guards; general repairs to deck and cabin.
Quarter boat No. 17	280.15	Damage done during storm of July 1, 1894, to guards and cabin, repaired.
Quarter boat No. 19	92.79	General repairs, new head block, repairs to guards, cabin, and storeroom.
Quarter boat No. 31	261.45	General repairs to cabin, sleeping rooms, and offices.
Quarter boat No. 38	80.20	Repairs to rakes and cabin; calking.
Quarter boat No. 60 (Louisiana).	68.18	Minor repairs. Condemned.
Quarter boat No. 86	46.29	Repairs to cabin apd guards; rakes calked.
Quarter boat No. 87	58.00	Do.
Quarter boat No. 88	39.88	Repairs to guards and cabin.
Quarter boat No. 142 (Chester)	38.31	Minor repairs; cabin transferred to barge 136. Barge 142, hull of Chester, condemned.
Quarter boat No. 154	29.35	Repairs to cabin, guards, and storeroom.
Quarter boat No. 155	21.90	Repairs to cabin and guards.
Quarter boat No. 156	51.22	Repairs to cabin, guards, and shelving in dining room.
Quarter boat No. 157	23.31	Minor repairs during season.
Quarter boat No. 158	104.20	Repairs to guards and minor repairs during season.
Quarter boat No. 159	50.85	Repairs to cabin and guards, calking sides and rakes.
Barge Apache	80.95	Calked above light water.
Barge Cheyenne	101.42	Calked above light water; sides repaired.
Barge Chinook	92.40	Calked above light water; sides repaired (sunk and lost, loaded with stone, September 1, 1894, at Pilchers Point, La.).
Barge Comanche	58.51	Calked above light water; sides repaired.
Barge Maricopa	63.74	Do.
Barge Mohave	91.10	Do.
Barge Nez Perces	127.29	Do.
Barge Piute	136.83	Do.
Barge Shoshone	38.09	Calked above light water.
Barge Uintah	21.97	Calked, upper seams.
Square barge No. 79	47.49	Rakes and sides calked.
Square barge No. 82	46.97	Do.
Square barge No. 83	138.67	Put on pontoon deck, new rake stems and new rakes; calked above light water.
Square barge No. 84	14.92	Minor repairs.
Square barge No. 85	32.47	Do.
Square barge No. 108	213.07	Docked; gunwales, rakes, and bottom repaired with new material; calked.
Square barge No. 111	240.51	Docked; repairs same as preceding.
Square barge No. 135	36.98	Rakes and sides calked.
Square barge No. 136	99.82	Cabin of Chester transferred from condemned barge No. 142 and fitted up.
Square barge No. 137	17.09	Minor repairs.
Square barge No. 138	34.29	Rakes and sides calked.
Square barge No. 532	1.75	Repairs to pump (sunk and lost during the storm of July 1, 1894).
Square barge No. 535	1,378.29	Docked; new gunwales, streamers, inrakes, head blocks, kevels, and deck; barge rebuilt except bottom and bulkheads.
Square barge No. 540	1.75	Repairs to pumps.
Square barge No. 541	49.98	Rakes and sides calked.
Square barge No. 542	46.88	Do.
Square barge No. 544	348.22	Repairs to gunwales, deck, and deck beams; calked above light water; repairs during season.
Square barge No. 545	82.50	Sides and rakes calked; deck repaired.
Square barge No. 546	64.38	Do.
Square barge No. 547	41.52	Do.
Square barge No. 549	302.47	Docked; bottom frame and gunwales repaired; part of deck relaid; bottom, sides, and rakes calked.
Square barge No. 551	68.90	Sides and rakes calked; new hatch covers.
Square barge No. 552	55.24	Do.
Square barge No. 553	175.65	Rakes repaired; sides and rakes calked; new hatch covers; docked.
Square barge No. 554	53.36	Sides and rakes calked; new hatch covers.
Square barge No. 555	41.83	Do.
Square barge No. 556	62.91	Do.
Square barge No. 557	47.43	Do.
Square barge No. 558	82.20	Rakes repaired; sides and rakes calked; new hatch covers.
Square barge No. 559	63.22	Do.
Square barge No. 560	45.97	Sides and rakes calked; new hatch covers.
Square barge No. 561	47.95	Do.
Square barge No. 562	40.95	Do.
Square barge No. 563	44.17	Do.
Square barge No. 564	46.80	Do.
Square barge No. 565	39.59	Do.
General-service barge No. 45	3.50	Repairs to pumps; condemned.
General-service barge No. 135	4.37	Do.
General-service barge No. 182	30.02	Sides and rakes calked.

Statement of repairs to plant, third district, improving Mississippi River, etc.—Continued.

Number or name.	Cost.	Remarks.
Square barge No. 201	$148.28	Sides and rakes calked; extra timber heads put in; deck sheathed.
Square barge No. 204	573.47	Docked; two strakes of plank above knuckles put in; new rake frame; one-half of rakes made new and calked.
Square barge No. 205	169.24	Sides and rakes calked; deck sheathed; gunwales repaired.
Square barge No. 207	131.62	Do.
Square barge No. 210	629.51	Docked; new head blocks and rakes; calking and minor repairs.
Square barge No. 214	135.97	Sides and rakes repaired; calked.
Square barge No. 216	474.83	Docked; sides and rakes repaired; two new strakes of plank above knuckles put in; calking and minor repairs during season.
Square barge No. 217	33.43	Sides and rakes repaired and calked.
Square barge No. 219	133.21	Do.
Square barge No. 220	33.54	Sides and rakes calked.
Square barge No. 224	60.06	Sides and rakes repaired; calked.
Square barge No. 225	61.34	Do.
Square barge No. 226	155.73	Sides and rakes repaired; calked; extra timberheads put in and deck patched.
Square barge No. 230	123.12	Sides and rakes repaired; calked.
Fuel barge E	742.91	Docked; new head blocks and new rake plank; bottom, sides, and rakes calked.
Fuel barge A	889.78	Do.
Fuel barge F	735.08	Docked; new head block and new rake plank; sides sheathed; bottom, sides, and rake calked.
Grader No. 1	1,117.84	Docked; sides and rakes calked; repairs to hull; cabin and machinery repaired during season; boat now on dock undergoing thorough repairs.
Grader No. 3	3,852.17	Sides and rakes calked, new pump cylinders, new liners for air pump; machinery and pipe work repaired; minor repairs during the season.
Grader No. 77	354.81	Sides, rakes, and deck calked; new well for suction pump; new coal bunkers and repairs during season.
Pile driver No. 31	19.75	Minor repairs (sunk and lost in storm of July 1, 1894).
Pile driver No. 54	18.50	Minor repairs.
Pontoon dock, old	149.07	New trunks; dock repaired; calked.
Pontoon dock, new	394.29	Constructed Sept. 1, 1894.
Machine shop	338.79	Sides and rakes calked; repairs to tools and machinery; repairs to guard and cabin.
Carpenter shop	207.88	Sides and rakes calked; pulleys for circular saw changed; deck calked; break in bottom bulkhead repaired; repairs to machinery during season.
Mattress boat No. 26	4,525.28	New; built on dock at Greenville, Miss.
Mattress boat No. 27	4,152.90	Do.
Mattress boat No. 32	744.86	Docked; new timberheads; new bitts and platform; rakes sheathed; bottom and sides calked.
Mattress boat No. 192	412.62	Docked; new rake plank; new mattress ways and platform; sides and rakes calked (changed from barge No. 192 to mat boat No. 192).
Mattress boat No. 33	769.02	Docked; new timberheads; bottom repaired; rakes and sides sheathed; bottom, rakes, and sides calked.
Mattress boat No. 184	143.45	Docked; hull found to be rotten; repairs abandoned; ways transferred to mat boat No. 188.
Mattress boat No. 188	1,429.76	Docked; new bottom gunwale in sides and bulkheads; new end bulkheads; new streamers in rakes; rakes, deck, and bottom calked; ways transferred from mat boat No. 184.
Skiffs (21)	179.84	Repaired and calked.
Calking flats	214.11	Three built new.
Dry dock	423.44	Sides broken in during storm, repaired; new ventilators; machinery repaired during the season.
Stern dock	6.50	Putting in valves.
Tramway	521.39	Engine and boiler set up; house built and tramway constructed for the purpose of transferring lumber and material from barges to the top of the bank.
Miscellaneous.		
Coal boxes	39.45	
Office furniture	93.08	
Current meter	18.00	
Rock chute	39.64	
Wheelbarrows	130.72	
Pumps	10.50	
Cooking utensils	56.25	
Second district plant:		
Barge No. 74	10.05	Repairing platform and stanchions.
Barge No. 94	6.00	Repairing platform.
Barge No. 1	34.70	Calking sides and rakes and repairing same.
Barge No. 2	3.50	Rebolting head block.
Mat boat	45.90	Put on pontoon dock; hole in bottom of rake repaired.
Total	43,423.40	

Following is a list of barges, etc., taken out on dock and repaired during the season: Eight square barges, 3 fuel barges, 5 mat barges, 1 quarter boat, 2 steamboats, 1 grader (undergoing thorough repairs).

The cost of twelve months of caring for the floating plant and property and outfit thereon was $29,647.79.

The average number of employees engaged in this service was 47. The average daily cost of subsistence for employees engaged in superintendence, care, and repair of plant was $0.318.

Very respectfully,

ARTHUR HIDER,
Assistant Engineer in Charge.

Capt. C. McD. TOWNSEND,
Corps of Engineers, U. S. A.

REPORT OF SUPERINTENDENT OF CONSTRUCTION L. L. GILKEY ON REVETMENT WORK AT ASHBROOK NECK, MISSISSIPPI.

GREENVILLE, MISS., *March 15, 1895.*

SIR: The following final report of construction and repair work on revetment at Ashbrook Neck, Mississippi, from December, 1894, to March, 1895, is respectfully submitted:

The repair work was commenced December 18, 1894, and main mat party was transferred from Greenville December 23, mat building being commenced December 24. The work, after numerous delays from bad weather, ice, cold, and short force, was finished February 28 and main party towed in to Greenville, the remainder of plant being brought in by tug *Parker* March 2.

The work covered a period of 67 days, 9 of these being Sundays; working days, 58.

Force account.

Superintendence	6
Laborers and watchmen	136.4
Towing	13.2
Subsistence	9
Average force, labor (not including graders)	164.6.

Mattress work.—Two main mats were put in, extending from Stations 150 + 60 to 137 + 85. The dimensions were:

	Feet.	Squares.
Mat No. 1	712 by 280	
Mat No. 2	597 by 280	
	1,309 by 280	= 3,665.2

The construction was the same as at Greenville—four weaves to the launch, turns covered with loose brush, and the first hundred feet from shore covered with one layer of loose brush laid carefully with butts toward shore. The first mat was commenced December 24 and both completed and sunk in place by January 22, 1895. A delay of nearly ten days occurred in this work due to short force and bad weather. Three thousand six hundred and sixty-five and two-tenths squares; cost, $17,940.28; average cost, $4.897 per square.

Grading bank.—Grader No. 77; hose, 4 inches; nozzle, 1⅛ inches; pressure, 175 pounds; water crew, 12; commenced work on January 10, 1895, after sinking of mat No. 1, and worked until January 22, when high water stopped the work. Grader was returned to Greenville on 23d. Days, 12; 305 linear feet graded; cost, $563.87; average cost per foot, $1.8567.

Grader No. 1; hose, 4 inches; nozzle, 1⅛ inches; pressure, 130; crew, single, 14, double, 28, began work on 9th of January and worked until January 22, being forced to lay up at that time by high water. A single crew was employed at this time. On February 6 started up again; lost 7th by cold; force was increased to two eight-hour shifts on the 9th and grader worked until the 20th, when work was finished, grader being returned to Greenville on 21st. Nine hundred and ninety-five feet bank graded; cost, $1,705.82; average, $1.7133 per linear foot.

NOTE.—This extra cost was occasioned by ground being frozen 3 to 5 inches thick on last 400 feet.

Dressing grade.—This work was very light, as slope stood well and graders finished it nearly. One thousand three hundred linear feet graded dressed; cost, $325.56; average, 25.04 cents per linear foot.

Paving bank.—After the sinking of the two main mats, the pocket mats, and shore connection this work was commenced and continued until closed down on February 28. The work was badly delayed for lack of stone, the heavy ice running preventing it from being towed when needed. One thousand eight hundred and eighty-nine and seven-tenths squares; cost, $8,800.17; per square, $4.669.

Clearing.—Five and two-tenths acres were cleared at an expense of $222.89, or an average of $42.86 per acre.

Pocket mat (Station 23).—A pocket mat 200 by 200 feet was placed in the eddy pocket at the lower end of the work; begun on January 22, finished and sunk in place on 29th, one and a half days being lost by bad weather. Of this, 56 by 320 feet exposed by falling river was paved, amount being included in cost. Four hundred squares mat; cost, $3,219.67; average cost per square, $8.04917.

Repairs to old work.—Beginning December 19, 1894, and completed on January 13, 1895, 2,631 cubic yards stone was placed on old work and stone distributed where needed on the whole front of old work. Cost, $5,277.34; cost for each day's labor (including medical attendance and serving subsistence), $1.1659; cost for each day's labor for subsistence, $0.31984; total, $1.48578. Deducting the cost of repairs to old work and the pocket mat from the gross amount expended, leaves $38,576.34 as the net cost of new work completed. Station 137+85 to Station 150+60 equals 1,275 linear feet; average per foot, $30.256.

Labor per unit statement.

Kind of work.	Hours applied.	Per unit.
Mat building, 3,665.2 squares	26,557	$7.25
Shore connections, 714.5 squares	3,532	5.00
Paving bank, 1,889.7 squares*	18,000	9.52
Clearing bank, 5.2 acres	1,200	23.10
Grading bank, 1,300 linear feet	6,032	4.64
Dressing grade, 1,300 linear feet	1,753	1.35
Total for 1,275 linear feet completed work	57,074	.....

*Includes placing stone on shore connection after water fell.

An average of 43.9 hours per linear foot.

Statement of cost, Ashbrook Neck.

Kind of work.	Pay roll.	Subsistence.	Material.	Total.	Labor cost.	Material cost.	Total per unit.
Superintendence	$1,212.00	$73.23	.....	$1,285.23	.....	.....	.....
Mat building, 3,665.2 squares	3,870.90	1,061.73	$13,007.65	17,940.28	$1.348	$3.549	$4.897
Shore connection, 714.5 squares	514.83	141.21	2,188.95	2,844.99	.9181	3.0636	3.917
Grading bank, 1,300 linear feet	1,926.51	396.06	272.65	2,595.22	1.7806	.2097	1.9903
Clearing, 5 2 acres	174.92	47.97	.....	222.89	42.86	.....	42.86
Paving bank, 1,889.7 squares	2,450.34	719.62	5,630.21	8,800.17	1.6822	2.9871	4.669
Towing	1,850.06	401.43	1,363.01	3,614.50	.....	.....	.....
Memphis office and sundries	789.83	.....	483.23	1,273.06	.....	.....	.....
Amounts expended, new work	12,789.39	2,841.25	22,945.70	38,576.34	*30.256	.....	.....
Repairs to old work	1,067.09	292.69	3,917.56	5,277.34	.....	.....	.....
Pocket mat, Station 28	740.41	155.54	2,323.72	3,219.67	*2.2398	*5.8093	*8.0491
Total expended	14,596.89	3,289.48	29,186.98	47,073.35	.....	.....	.....

* New work, cost per linear foot.

Total net cost, 1,275 feet new work completed	$38,576.34
Average net cost per foot, new work completed	30.256
Average net cost per foot, new work—	
For labor	8.866
For material	16.548
For towing	2.834
Memphis office, property and sundries	1.009
Superintendence	1.002

Material per unit statement.

Kind of work.	Stone.	Brush.	Poles.	Wire.	Wire strand.	Spikes.	Coal.
	Cubic yds.	*Cords.*	*Cords.*	*Pounds.*	*Pounds.*	*Pounds.*	*Bushels.*
Mat work, 3,665.2 squares	1.1126	1.1601	0.214	7.04	3.77	1.255	.....
Shore connection, 714.5 squares	.9738	.801	.20	9.14	5	.975	.....
Paving bank, 1,889.7 squares	2.001	.....	.....	.....	.....	.....	.....
Grading bank, 1,300 linear feet	.....	.....	.....	.....	.....	1.57	1.57
Pocket mat, Station, 28,400 squares	2.0587	1.0475	.20	9.24	5	1	.....
Total consumed, pocket mat not included	9,443.68	5,243	1,009.1	36,150	19,165	5,700	17,385.25
Average consumed per linear foot, pocket mat not included (1,275 feet new work)	6.76	4.112	.791	28.35	15.03	4.47	13.63

Percentage of cost.

Items.	Amount.	Percentage.
Superintendence	$1,285.23	3.4
Labor and subsistence	11 304.09	29.4
Material	21.099.46	54.7
Memphis office, property and sundries	1,273.06	3.1
Towing	3,614.50	9.4
Total	38,576.34	100

Towing.—The steamer *Osceola* was employed from December 21 to January 31, inclusive, and the steamer *Vedette* towed five barges stone from Greenville. The expense of tug *Parker* has all been charged to harbor work.

Cost of *Osceola* and *Vedette*	$2,131.41
Deduct towage 6,252.1 cords brush and poles	625.21
Cost towing stone	1,506.20

Average cost per yard for 12,075 cubic yards, 12.47 cents.

Tug *Parker* was employed from December 23 to March 3. Cost, $1,483.07. Average cost per day, $21.189, all charged against harbor work. This boat handled from Greenville five barges stone, and nine barges brush and poles from Wilkersons Towhead. Captain Davidson and Engineer Shaw have rendered very efficient service, and the use of the tug has been very valuable to the work.

The employees generally have kept up the same standard of efficiency reported on the Greenville work. Statement of cost, list of expenditures (omitted), and distribution of charges attached.

Very respectfully,

L. L. GILKEY,
Superintendent Construction.

Mr. ARTHUR HIDER,
United States Assistant Engineer.

Statement of cost, Ashbrook Neck.

Items.	Received.		Returned to plant.		Expended.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Pay roll		$13,807.06				$13,807.
Subsistence		3,655.67		$366.19		3,289.
Pay roll, Memphis office		789.83				789.
Brush, cords	5,243	5,610.12			5,243	5,610.
Poles, do	1,009.1	1,765.92			1,009.1	1,765.
Stone, cubic yards	11,151.2	16,615.66			11,151.2	16,615.
Stone from reserve, $1.749 per cubic yard	923.48	1,615.16			923.48	1,615
Stone from reserve, loading same		152.00				152
¾ inch wire strand, pounds	5,600	195.44	1,500	52.35	4,100	143
½ inch wire strand, do	40,951	1,027.87	25,886	649.74	15,065	378
Galvanized wire, No. 12, do	39,225	717.81	3,075	56.27	36,150	661
Spikes, assorted, do	12,100	220.39	6,400	112.00	5,700	108
Nails, keg	1	1.60	1	1.60		
Coal, tons	814.41	1,751.20	119	255.85	695.41	1,495
Coal bills, L. B. Musgrove		4,949.95		4,949.95		
Headlight oil, gallons	595	59.14	30	3.60	565	55
Signal oil, do	98½	26.11	51½	18.03	47	
Mecca oil, do	50	6.00	50	6.00		
Cylinder oil, do	302	143.40	107	80.25	195	6
Packing, assorted, pounds	200	54.56			200	5
Iron, do	400	10.00			400	1
Manog. Pid. I. Co., staples		78.01		78.01		
C. B. Jones, forms, Memphis office		14.00				1
Noland Fontaine, rent		88.33				8
L. Simpson, water		15.00				1
R. C. Graves, ice		27.38				2
W. W. Carnes, electric current		3.67				
Post-office, stamps and box rent		6.00				
W. A. Beamer, transportation		15.05				1
J. T. Jamison, traveling expenses		15.40				1
Noland Fontaine, rent		88.33				8
Property purchased		162.63				16
Valves, dozen	6	7.20			6	
Lantern globes	12	7.30			12	
Total		53,703.19		6,629.84		47,073

Distribution of expenditures.

Superintendence:		
Pay roll (341 days)	$1,212.00	
Subsistence	73.23	
		$1,285.
Steamers *Osceola* and *Vedette*:		
Pay roll (548 days)	1,013.68	
Subsistence	273.60	
Coaling, pay roll (302 hours)	44.03	
Subsistence	12.07	
357 tons coal	767.65	
Traveling expenses Jesse Jamison	15.40	
		2,131.
Grader No. 1:		
Pay roll (818¾ days)	1,273.84	
Subsistence	243.27	
Coaling, pay roll (156 hours)	22.75	
Coaling, subsistence	6.25	
51.8 tons coal	111.38	
100 pounds packing	27.28	
65 gallons oils	21.05	
		1,705.
Grader No. 77:		
Pay roll (247¾ days)	363.33	
Subsistence	73.44	
Coaling, pay roll (76 hours)	11.08	
Coaling, subsistence	3.05	
30 tons coal	64.61	
100 pounds packing	27.28	
65 gallons oils	21.05	

Tug *Parker*:		
Pay roll (340 days)	$719.47	
Subsistence	90.77	
Coaling, pay roll (500 hours)	72.88	
Coaling, subsistence	19.99	
256.61 tons coal	551.71	
Valves	7.20	
Lubricating oil, 65 gallons	21.05	
		$1,483.07
Field work:		
Pay roll, at 14.5758 cents per hour (7,321 hours)	1,067.09	
Subsistence, at 3.9978 cents per hour	292.69	
2,631 cubic yards stone, at $1.489	3,917.56	
		5,277.34
Caving bank:		
Subsistence	719.62	
Pay roll (18,011 hours)	2,450.34	
3,781.2 cubic yards stone, at $1.489	5,630.21	
		8,800.17
Miscellaneous:		
565 gallons headlight oil	55.54	
12 dozen lantern globes	7.30	
Property purchased	162.63	
		225.47
Clearing 5.2 acres:		
Pay roll (1,200 hours)	174.92	
Subsistence	47.97	
		222.89
Shore mat:		
Pay roll (3,532 hours)	514.83	
Subsistence	141.21	
608.5 cubic yards stone	906.03	
100 cubic yards stone	174.90	
572 cords brush	612.04	
1,430 cords poles	250.25	
6,630 pounds wire, at 1.83 cents	121.33	
3,572.5 pounds wire strand	106.90	
700 pounds spikes	17.50	
		2,844.99
Mat work:		
Pay roll (26,5[illegible]7 hours)	3,870.90	
Subsistence	1,061.73	
4,130.3 cubic yards stone, at $1.489	6,161.86	
4,252 cords brush	4,549.75	
786.1 cords poles	1,375.67	
1,339.25 pounds wire strand	346.12	
25,808 pounds wire strand	472.28	
4,600 pounds spikes	83.89	
47 gallons signal oil	8.08	
400 pounds iron	10.00	
		17,940.28
Pocket mat, Station 28—400 squares:		
Pay roll (3,280 hours)	740.41	
Subsistence	155.54	
823.48 cubic yards stone, at $1.749	1,440.26	
Loading same	152.00	
419 cords brush	448.33	
80 cords poles	140.00	
3,712 pounds wire, at 1.83 cents	67.93	
2,000 pounds wire strand	68.20	
400 pounds spikes	7.00	
		3,219.67
Memphis office:		
Pay roll, November and December	789.83	
C. B. Jones, blank forms	14.00	
Noland Fontaine, rent	176.66	
L. Simpson, water	15.00	
R. C. Graves, ice	27.38	
W. W. Carnes, electric current	3.67	
Postmaster, box rent and stamps	6.00	
W. A. Beamer, transportation	15.05	
		1,047.59

Dressing grade, 1,300 linear feet:		
Pay roll (1,753 hours)	$255.51	
Subsistence	70.05	
		$325.56
Total		47,073.35

REPORT OF SUPERINTENDENT OF CONSTRUCTION L. L. GILKEY ON REVETMENT WORK AT GREENVILLE HARBOR.

GREENVILLE, MISS., *March 5, 1895.*

SIR: The following final report on construction work and repairs done on Greenville front from September, 1894, to February, 1895, is respectfully submitted:

The work was commenced September 17, 1894, under supervision of Mr. George C. Thomas, superintendent of construction, with a force of 60 men and 2 foremen, removing stone from breaks in old work from Stations 55 + 50 to 62. This work was finished September 20 and force worked from that time until October 10. Mr. Thomas was transferred to Lake Providence October 8 and I took charge of the work on that day, transferring most of his foremen with him and partially reorganizing the force.

The main work extended from September 17 to December 22, 1894, 97 days, less 13 Sundays, leaving 84 working days.

Following is the average force account:

	Men.
Labor	162
Graders	17
Subsistence and hospital	5
Superintendence	3
Towing (coaling and extra included)	23
Average force daily	210

On December 22 the mat party finished work and was transferred to Ashbrook Neck. After this time a force of men worked until January 27, 1895, 36 days, making altogether 1,138½ days to finish paving bank. This work was somewhat delayed by bad weather during January. The work done:

	Linear feet.
Repair work (new) Greenville front proper (Station 54 + 92 to Station 76, less dike, 41 feet)	2,067
Added in upper end of Bachelors Bend (Station 96 + 32 to Station 106 + 52)	1,020
Total	3,087

The whole of old work of seasons of 1890, 1891, and 1892 was gone over at a very low stage of water (from 3 feet above to 3 feet below zero), stone distributed, small defects repaired, and 3,540 cubic yards new stone added near water line on exposed mat. In addition to this 1,380 cubic yards stone was used, secured from breaks on work replaced by new. Considerable trouble from caving bank occurred during the early part of the work, 500 feet of hydraulic grading and nearly 150 feet of hand grading being lost from this cause. Aside from this, the delay waiting on material at commencement of work and the necessity of grading 715 feet of work by hand, no unusual difficulties and practically no delay attended the work until mat building was finished, on December 22, the weather being fine and labor plentiful.

Grading bank—hydraulic graders.—Grader No. 77 was placed at work in the pocket between Stations 55 and 61 September 22 and worked until November 10 with two lines 2½-inch hose, nozzle 1¼ inches, crew 12; was changed on the 10th to one line 4-inch hose (by your direction), nozzle 1⅝ inches, pressure 190 pounds. A marked improvement in quantity of work was shown at once. Grader worked until November 13, in all 46 days, and was transferred to Mr. Thomas for use at Lake Providence on November 13. Work done, 868 linear feet grade; cost, $1,490.97; average cost per linear foot, $1.718. (This does not include 60 feet of grade lost).

Grader No. 1 (water end of one pump badly cracked; water pressure 130 to 145 pounds; hose, 4 inches; nozzle, 1⅝ inches and 1¼ inches.) Commenced work October 4 and worked with a single crew until October 12; from that time until 23d a double crew was employed. Time of single crew, 9 days, less 2 Sundays; time of double crew, 11 days, less 4 Sundays; total single crew, 21 days; work done, 702 linear feet; cost, $1,085.74; average cost per linear foot, $1.5466 (not including 35 feet of grade lost by caving.) The cost of finishing work done by this grader was very small.

Grader No. 3, running one pump only; pressure, 130 pounds; hose, 4 inches; nozzle, 1⅝ inches; commenced work on the 24th of October. Lost 24th, 25th, and 29th of October on repairs, and ran until November 17, being then transferred to Mr. George C. Thomas for use at Lake Providence. Owing to underlying sand, slope gullied badly after this grader and grader No. 77, and grade could not be finished well. Time, single crew, 24 days; three Sundays off leaves 21 working days. Work done, 785 linear feet; cost, $1,028.59; average cost per linear foot, $1.3103.

Hand grading.—Owing to the proximity of the levee between Stations 55 and 61 + 50, and the fact that the underlying strata of sand would not stand hydraulic grading, this part of the work was done by hand and with teams at a very heavy expense. The average per foot of this work was cut down very much by the grading of 165 feet of light work at ends of work. Total work done, 715 linear feet; cost, $2,922.29; per foot, $4.08.

Dressing grade by hand and with teams was commenced October 20 and finished November 30. Work done, 2,355 linear feet; cost, $2,673.49; average cost per linear foot, $1.131.

The cost of completed grade, slopes 3½ and 4 to 1, including hand, team, and hydraulic grading, and dressing grade, was $9,201.08, an average cost per linear foot of $2.994.

Explosives were used in the early part of the work by Mr. Thomas to loosen up or turn over the upper bank. This was continued after he left on the first 2,000 feet of work, but was then abandoned, the loosening of the earth causing the danger of an overfall on the nozzleman to be so great that an increased distance in playing stream weakened cutting force to such an extent that the gain from explosives, if any, is doubtful.

Mat building.—The building of pocket mat was commenced on arrival of brush, October 10, and of main mat, October 23, on arrival of three-eighths inch wire strand necessary, and continued until December 22, when the work was completed and party transferred to Ashbrook Neck.

Five channel mats were put in as follows:

	Squares.	
Main mat:		
No. 1, 830 by 200 feet	1,660	
No. 2, 702 by 280 feet	1,965.6	
No. 3, 525 by 280 feet	1,470	
No. 4, 600 by 280 feet	1,680	
No. 5, 540 by 280 feet	1,512	
Total (3,197 linear feet)		8,287.6
Pocket mat:		
No. 1, 550 by 105 feet	577.5	
Nos. 3 and 4	704	
Shore connection	613	
		1,894.5
Total mat work		10,182.1

The method of construction used for these mats was, for mats Nos. 1, 2, and 3 the same as used by Mr. Thomas at Delta last year; for mats Nos. 4 and 5 an extra layer or covering of one thickness of brush was extended over the whole of the mat, the top layer being laid parallel to the bottom one; this makes a very close mat, but poled the old way (spacings 8 feet) is very stiff.

Towing.—The towing necessary at the work and handling stone barges to and from the Georgia Pacific Tipple and fleet was done by the tug *Parker*, in commission from September 17 to December 22, ninety-seven days, at a cost of $1,837.73, an average per day of $19.98.

The steamer *Osceola* was placed in commission October 1, 1894, and made one trip to Memphis after brush barges, and was employed towing brush for this work until December 20, being transferred on the 21st to Ashbrook Neck. The only use made of this boat was brush and pole towing, so that this expense has been charged in cost of these items of material, the cost being for towing, 28.127 cents per cord, less amount charged back to contractors, 3.582 cents; net cost, 24.545 cents. Days in commission, 81; average cost per day, $49.42. Barges to and from brush camp, 63; barges between brush camp and work (and Ashbrook Neck), 16. (A deduction from fuel made to cover).

Paving bank.—Owing to the unusually low stage of the water this work was done in advance of mat building half way up the slope; the condition after grading had been done made it seem safe to do so. This work was finished January 27, 1895. Work done, 32,875 squares.

Material.—Brush and poles were obtained by contract from Messrs. Hunter & Frey, contractors, the supply being about sufficient for the needs of the work, though some delay ensued from shortage in delivery in December.

Stone.—6,053.4 cubic yards of stone was used from White River stone at fleet, and 18,045.2 cubic yards stone was obtained under contract with J. B. & W. L. Killebrew, delivered on barges.

The percentage of cost of the different items of work was (old work not included):

Items.	Charge.	Per cent.
Pay roll	$24,578.41	28.4
Subsistence	4,191.60	4.8
Material	55,033.46	63.7
Property and miscellaneous	2,691.28	3.1
Total	86,494.75	100

The percentage of cost of the several kinds of work was:

Kind of work.	Charge.	Per cent.
Superintendence	$1,356.83	1.57
Mat work	45,846.71	53.10
Pocket mat and shore connection	9,577.14	11.07
Grading bank and dressing grade	9,201.08	10.62
Paving bank and surface drains	15,683.53	18.08
Towing	1,837.73	2.11
Surveys	300.45	.34
Property, office, and miscellaneous charges	2,691.28.	3.11
Total	86,494.75	100

In conclusion I wish to thank my subordinates generally, and especially Messrs. B. Baumgarden, head foreman; Frank Reinhold, mat foreman, and Gerard Brandon, commissary, for the satisfactory manner in which the duties of their several positions have been performed.

The different items of cost will be found in the statements attached—list of charges and expenditures, distribution of expenditures, and statement of charges to be made against Lake Providence Reach and Ashbrook Neck—herewith.

Very respectfully,

L. L. GILKEY,
Superintendent of Construction.

Mr. ARTHUR HIDER,
United States Assistant Engineer.

Statement of cost, Greenville Harbor.

Classification of work and units.	Pay roll.	Subsistence.	Material.	Total.	Unit of cost, labor.	Unit of cost, material.	Total.
Superintendence	$1,271.25	$85.58		$1,356.83			
Mats 1 and 3, 5,095.6 squares	5,223.97	1,145.50	$19,577.38	25,946.85	$1.249	$3.842	$5.092
Mats 4 and 5, 3,192 squares	4,010.09	879.32	15,010.45	19,899.86	1.532	4.702	6.234
Pocket mats, 1,282.3 squares	1,493.30	327.43	4,602.47	6,423.20	1.42	3.589	5.009
Shore connection, 613 squares	564.26	123.72	2,465.96	3,153.94	1.122	4.023	5.145
Hand grading, 715 linear feet	2,449.27	361.97	111.05	2,922.29	3.931	.155	4.087
Hydraulic grading, 2,355 linear feet	4,769.60	666.04	843.15	6,278.79	2.308	.358	2.666
Paving bank, 3,287.5 squares	3,240.55	377.86	11,969.96	15,588.37	1.103	3.641	4.744
Surface drains (4)	78.04	17.12		95.16			
Miscellaneous and property				2,691.28			
Surveys	250.17	50.28		300.45			
Towing	1,227.91	156.78	453.04	1,837.73			
Total cost new work	24,578.41	4,191.60	55,033.46	86,494.75			
Amount expended on old work	1,588.24	348.26	4,083.17	6,019.67			
Total expended	26,166.65	4,539.86	59,116.63	92,514.42			
Steamer Osceola (included in material)	2,361.04	578.04	1,063.94	4,003.02			
Less amount charged Hunter and Frey				510.66			
Net amount charged in material				3,492.36			

Average cost of new work, 3,087 linear feet, $86,494.75; equal to $28.02 per linear foot.

Material per unit statement.

Kind of work and quantity.	Brush.	Poles.	Stone.	Wire strand.	Spikes.	Staples.	Wire.	Coal.
	Cords.	*Cords.*	*Cub. yds.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bushels.*
Mats 1 and 2, 5,095.6 squares	1.1674	0.1924	1.0564	4.809	0.97	0.058	9.28	.....
Mats 4 and 5, 3,192 squares	1.474	.206	1.3413	6.108	.9302	.0601	9.302	.....
Pocket mat, 1,282.3 squares	.90	.201	1.114	4.124	.97	.....	9.284	.....
Shore connection, 613 squares	.899	.191	1.500	9.285	1.024	.....	9.285	.....
Hydraulic grading, 2,355 linear feet	.....	.....	.....	.....	.....	.....	.....	2.55
Paving bank, 3,287.5 squares	.....	.....	2.600	.....	.....	.....	.....	.....
Total consumed	12,216.66	2,011.6	20,558.29	49,294	9,900	500	94,571	194
Total per linear foot new work, 3,087 squares	3.96	.651	6.66	16	3.2	.16	30.63	6.29

Labor per unit statement.

Kind of work and quantity.	Hours applied.	Average.	Per foot, complete work.
Mats 1, 2, and 3, 5,095.6 squares	32,135	*6.362	15.546
Mats 4 and 5, 3,192 squares	24,668	*7.728	24.184
Pocket mat, 1,282.3 squares	9,186	*7.163	4.100
Shore connection, 613 squares	3,471	*5.662	§
Grading bank, 715 linear feet	†10,155	‡14.203	16.62
	§1,728	‡2.417	§
Grading bank (hydraulic), 2,355 linear feet	11,845	‡4.8	4.80
Dressing grade, 2,355 linear feet	†8,262	‡3.63	4.592
	§2,268	‡.962	§
Paving bank, 3,287.5 squares, 9,105 hours day labor, December and January	19,705	‡5.994	5.413

* Hours per square. † Hand. ‡ Hours per linear foot. § Teams.

Total for complete work, 3,087 linear feet, 123,423 hours, or 40 hours per linear foot.

NOTE.—This average is for actual length complete work, not counting laps of mats.

Recapitulation cost of labor.

Classification.	Hours expense.	Hours labor.	Pay roll.	Subsistence.
Hospital	2,292	.....	$493.83	$87.42
Serving subsistence	11,408	.....	1,286.90	383.79
Watching	2,968	.....	583.03	98.54
Hand and team grade	.....	10,155	1,518.98	236.48
Paving bank, old work	.....	9,770	1,396.30	258.29
Paving bank, new work	.....	10,600	1,487.22	331.24
Surface drains	.....	480	66.92	14.40
Dressing grade	.....	8,262	1,144.70	270.72
Mats 1, 2, and 3	.....	28,826	4,037.15	927.03
Mats 4 and 5	.....	22,699	3,155.39	692.16
Pocket mats	.....	8,353	1,174.22	269.30
Making wire	.....	6,509	905.00	208.85
Shore connections	.....	3,073	425.36	97.48
Total	16,668	108,727	17,675.00	3,875.70
Superintendence	.....	2,488	1,271.25	85.58
Tug Parker	.....	4,583	1,227.91	156.78
Grader No. 77	.....	4,988	1,053.28	160.96
Grader No. 1	.....	3,590	698.12	110.06
Grader No. 3	.....	3,267	674.98	100.50
Hand grade, teams	.....	1,768	798.44	.....
Dressing grade, teams	.....	2,286	1,000.12	.....
Steamer Osceola	.....	10,625	2,361.04	578.04
Grand total	16,668	142,322	26,760.14	5,067.62

Average cost per man for actual labor (pay roll)	$16.25622
Average cost per man for actual labor (subsistence)	3.56461
Total	19.82083

Receipts and expenditures.

Description.	Amount received.		Transferred to Lake Providence Reach.		Returned to plant.		Transferred to Ashbrook Neck.		Expended.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Pay roll		$28,527.69								$28,527.69
Subsistence		5,680.22				$14.99		$547.33		5,117.90
Stone, cubic yards	24,098.61	33,950.91							24,098.61	33,950.91
Brush, cords	12,216.6	13,071.76							12,216.6	13,071.76
Poles, do	2,011.6	3,520.30							2,011.6	3,520.30
Wire strand, ⅝ inch, pounds	107,149	2,689.38			*56.059	1,407.03	4,000	100.40	47,090	1,181.95
Wire strand, ¾ inch, do	7,804	303.77				31.41	5,600	195.44	2,204	76.92
Wire, galvanized, No. 12, do	104,571	2,248.86					1,000	183.00	94,571	2,065.86
Spikes, do	11,500	262.85					1,600	36.64	9,900	226.21
Staples, do	1,000	37.50			500	18.75			500	18.75
Lumber, feet, B. M	4,069	67.26							4,069	67.26
Nails, pounds	350	5.35					100	1.60	250	3.75
Lamp and lantern globes, number	252	17.80					108	6.30	144	11.50
Lamp and lantern burners and wicks		4.48								4.48
Signal oil, gallons	102	35.11					47	8.08	55	27.03
Headlight oil, do	851	100.73					247	29.64	604	71.09
Lubricating oil, do	594½	240.69	159½	$63.88			145	69.15	290	107.71
Stationery		96.71		21.17						75.54
Waste, pounds	112	8.96							112	8.96
Paints, do	119½	7.43							119½	7.43
Fuse, feet	600	5.80							600	5.80
Packing, pounds	500½	189.94	119	47.03			112	46.20	269½	96.71
Graphite, do	20	3.20							20	3.20
Emery cloth, quires	2	1.10							2	1.10
Oakum, bales	1	3.55							1	3.55
Iron, pounds	725	12.00							725	12.00
Powder, do	750	105.25							750	105.25
Dynamite, do	160	24.75							160	24.75
Axle grease, do	341	5.97							341	5.97
Cotton rope, do	82	13.12							82	13.12
Bolts and nuts, number	48	.25							48	.25
Caps, explosive, do	400	3.60							400	3.60
Leather, pounds	6	1.80							6	1.80
Putty, 5 pounds; glass, 20 panes		1.15								1.15
Drugs		62.22								62.22
Traveling expenses and transportation		29.15								29.15
Ax handles, dozen	4	7.40							4	7.40
Telegrams		6.28								6.28
P. J. Haberling, pads		3.00								3.00
Captain Townsend, mileage		160.94								160.94
L. B. Musgrove (not received)		1,232.00				1,232.00				

Coal ..... boxes..	9,045	2,371.21	305	91.50	98	278.70			776	2,001.01
Property purchased		2,792.66		547.15				18.76		2,226.75
J. H. Coffin & Co. (not received)		39.70				39.70				
Memphis office, rent		88.33								88.33
Memphis office, washing		4.50								4.50
Telephone rent, D. E. Thomas		12.50								12.50
Steamer Osceola, range center		1.75								1.75
Total		98,060.88		770.68		3,022.58		1,242.54		93,025.08
Less towage on brush and poles (charge Ashbrook Neck)								510.66		510.66
Total		98,060.88		770.68		3,022.58		731.88		92,514.42

*Correction.

REPORT OF SUPERINTENDENT OF CONSTRUCTION GEORGE C. THOMAS ON REVETMENT WORK AT LAKE PROVIDENCE, LA.

GREENVILLE, MISS., *March 29, 1895.*

SIR: The following final report of revetment work at Lake Providence, La., for the season of 1894-95 is respectfully submitted:

The work proposed was for the purpose of checking the encroachment of the river upon the Elton Levee, 1 mile above the town of Lake Providence, La. The plan originally adopted was for a system of subaqueous woven willow mats 280 feet wide, commencing about the center of the caving bank, Station 45, and extending downstream to and around the point at the upper Lake Providence Landing; thence from the point of beginning upstream as far as the low-water season would permit, the upper bank to be graded to a slope of 4 to 1 and covered with a stone paving 10 inches thick from a junction with inner edge of mat up to an elevation of 28 feet above zero of Lake Providence gauge.

Under instructions this plan was changed during the season by the introduction of fascine mats 300 feet wide for the upper 1,500 feet of the work and an entire change in the system of paving, a 6-inch flat paving being substituted for the 10-inch shingle paving previously in use.

The plant arrived on the work October 10, 1894, but owing to delay in obtaining line and cable active operations were not begun until October 20. Work closed down March 13, 1895, with a total of 4,803 linear feet of work completed during the season, at a cost of $29.85 per linear foot.

Clearing.—Eleven hundred feet of bank along the proposed work was covered with a growth of small timber, underbrush, and vines. This was cleared back beyond the slope line at a cost of $12.75 per acre. Total cleared, 3¾ acres.

Hydraulic grading.—Grader No 1, with a double crew, single line 4-inch hose, nozzle 1¾ inches, water pressure 135 to 140 pounds, was put in service October 25, 1894, and constantly employed sixteen hours per day (Sundays excepted) until December 18, 1894, when she was shut down and transferred to plant at Greenville. A second line of hose was introduced November 9, 1894, and operated for three days, when it was abandoned on account of increased leakage in fractured pump. Actual working time, 45 days; amount cut, 2,040 linear feet; average per day, 45.3 linear feet.

Grader No. 77 began work November 16, 1894 with a single crew, one line of 4-inch hose, nozzle 1¼-inches, water pressure 190 pounds, and was in service until December 10, 1894. Actual working time, 17 days; amount cut, 235 linear feet; average per day, 13.8 linear feet.

Grader No. 3, with single crew, single pump, one line 4-inch hose, nozzle 1⅞ inches, water pressure 160 pounds, was put in service November 20, 1894; shut down December 27, to await completion of mat under caving bank; resumed work January 5, 1895, and again shut down January 29 on account of high water; was again put in service February 7 with double crew, and completed the season on February 22. Actual working time, 56 days; amount cut, 2,725 linear feet; average per day, 48.7 linear feet.

The bank at this point is subject to four classifications, as follows: From Stations 17 to 25, a sandy loam overlying a stratum of blue gumbo at about the same elevation and dip of the slope line, affording a comparatively easy cut, with no tendencies toward gullying. From Stations 25 to 33, a 10-foot stratum of buckshot with gumbo underneath, the most difficult bank to cut that has as yet come under my observation. From Stations 33 to 48, buckshot with sand underneath, as successfully handled (by an experienced nozzleman) as the lower bank, where buckshot exceeds 5 feet in depth, as was the case for one-half this distance. The remainder of the bank consisted of pure sand and resulted in the usual gullying, until toward the close of the season, when it was obviated to a considerable extent by producing the upper cut from 200 to 300 feet ahead, giving the water pouring over the slope only sufficient fall to carry off the material cut.

From the above classification it is obvious that no legitimate comparison can be drawn of the work of the two large machines. In the same soil and under conditions similar to those under which they were working any superiority of the one over the other would, I believe, be due to the judgment of the foreman in charge, which is a greater essential to cheap grading than the size of the nozzle or the pressure behind it.

Slope dressing was done by means of shovels and teams with drag scrapers. Considerable scour occurred between Stations 20 and 24 during the January rise. This was regraded with shovels and teams and charged against "slope dressing." Total amount completed bank, 4,900 linear feet; cost hydraulic grading, $1.446 per linear foot; cost slope dressing, 63 cents per linear foot; total cost completed, $2.075 per linear foot.

Mattress construction was begun October 22, 1894, and completed February 23, 1895. Owing to a scarcity of barges at the beginning of the season and the failure of brush contractors (between the 1st and 15th of November) to supply the requisite amount of material for the employment of a full force the work was not pushed as rapidly as should have been done. Excepting these delays, everything was favorable for the rapid construction of this work up to January 15, 1895, when, owing to a high stage of water (24 feet Lake Providence gauge) and the great amount of drift running, it was considered unsafe to attempt further mattress construction until the water began to fall. Work was again resumed February 1 and the last channel mat was completed February 9.

Plant for construction of fascine mats arrived on the work December 11. Mat boats, fascine, and mooring barges borrowed from second district; remainder of outfit from plant at Greenville. An independent organization was formed for this work, was put in service December 18, and closed down January 26, 1895, with a total of 1,460 linear feet of mat built, including laps.

The following is the number, style, and dimensions of mats constructed and sunk during the season:

	Squares.
Channel mat:	
No. 1 (woven) 557 by 280 feet	1,550.6
No. 2 (woven) 610 by 280 feet	1,708
No. 3 (woven) 500 by 280 feet	1,400
No. 4 (woven) 736 by 280 feet	2,060.8
No. 5 (woven) 700 by 280 feet	1,960
No. 6 (fascine) 810 by 300 feet	2,430
No. 7 (fascine) 650 by 300 feet	1,950
No. 8 (fascine) 455 by 280 feet	1,274
Total 5,018 linear feet.	
Pocket mat:	
No. 1 (woven)	275
No. 2 (woven)	615
No. 3 (woven)	324.4
No. 4 (woven)	853
No. 5 (woven)	151.6
Shore connection (woven) mats Nos. 4 and 5	248.8

Total mat work	linear feet	5,018, or	17,810.2
Less amount laps	do	215	
Completed work	do	4,803	

Mats Nos. 1, 2, 3, and 4 woven similar in plan of construction to those of previous season, while for No. 5 the extra cover of brush was extended over its entire surface making a very close, thick mat, but considered too stiff for sinking safely when current exceeds a velocity of 4 feet per second.

Nos. 6, 7, and 8 were fascine mats, constructed upon the plan adopted in the second district, and are, in my opinion, far superior to the woven mat in every particular.

Considering the expense of equipping an independent outfit for the construction of but 1,500 feet of this work, the lack of experience of the force employed, and the disadvantages under which the work was carried on by reason of a constantly caving bank, no just conclusion can be reached as to the comparative cost of the two classes of work for a season, except as regards material which is found to be 17 per cent greater for the fascine mat.

Mats Nos. 1, 2, 3, 6, and 7 were sunk under a caving bank before grading, necessitating the construction of aprons or shore mats over all except No. 7 to connect them with the shore. After bank was graded connections were constructed on woven plan, with extra cover of brush omitted. Mat No. 7 was sunk at a high stage of water and the irregularities of the bank under the mat removed by hydraulic grading.

No unusual difficulties were encountered in sinking any of these mats. Considerable drift accumulated above the mooring barges on Mat No. 7 during the rise in January; this was held in place while sinking mat by means of cables fastened to rafts and coal shell in drift pile above mooring barges.

Mat No. 8, the last of the series, was caught in an ice gorge on February 13, and sinking delayed until the 21st. Some little trouble was experienced in holding this mat in place and protecting the outer mooring barge from being cut down. All manila lines were cut by the ice and steel cables substituted; considerable line lost and three cables parted. A sheeting of 2 inches cottonwood was at first used for the protection of the outer end of mooring barge, but was found to last only a short while and too much danger attending the replacing of it. A wire screen was then constructed of three-eighth-inch wire strand, 15 feet wide and 40 feet long, with

heavy chains top and bottom, wire woven through links in chain. This was thrown over and around the end of barge, with top chain securely fastened to timberheads on deck with slip lines for lowering to desired depth. This was found to be effective, and no further trouble was experienced.

Bank paving was begun November 17, 1894, and completed March 12, 1895, with a total of 6,329 squares for the season. As previously stated, the style of this paving was changed from that of previous years and a flat paving introduced. This change was made November 19, and was in force for the remainder of the season, excepting on a sample strip 100 feet wide, ordered by the officer in charge, and consisting of 3 inches of spalls overlaid with a single course of flat stone. The heavy rains toward the close of the season thoroughly demonstrated the superiority of this style of paving over any that has yet come under my observation for the protection of a sand slope against the action of surface water.

Surface drainage.—Paved drains, with 3-inch broken stone in bed, were introduced whenever necessary, and light levees thrown up along top of bank to prevent the indiscriminate passage of surface water over the slope. A dam was thrown across the old bayou at Station 22 and water from barrow pits drawn off through ditch cut for the purpose, discharging into the river below the upper landing.

Stone loading.—Twenty-eight thousand five hundred and twenty-nine cubic yards of stone used on this work was loaded from the reserve at Pilcher Point, La. Labor employed at $1.25 per day and board themselves. Cost of loading stone was 21.6 cents per cubic yard. Owing to the sloughing of the bank upon which this stone was unloaded and the vast amount of sediment deposited over it during last high water one-fourth of the amount loaded had to be worked out with picks, making the cost of loading a little in excess of what it would have been under ordinary circumstances.

Towing.—The steamer *Emma Etheridge* was put in service October 9, 1894, and constantly employed in towing material and general harbor work until the close of the season, March 14, 1895, when she was transferred to plant at Greenville. Time in service, 156 days; cost per day, $57.56.

Steamer *Vidalia* was put in commission November 27 and sent to Memphis for fascine-mat outfit; returning, arrived at works December 11 and was employed on towing material and harbor work until March 5, 1895, when she was transferred to towing stone. Time in service, 99 days; cost per day, $46.62.

Material.—Brush and poles were furnished under contract by Messrs. Hunter & Frey, loaded on Government barges. Material was obtained from Stack Island, Transylvania, Island 95, and Poverty Point, was of good quality and furnished in quantity sufficient for the demands of the work, excepting for the time previously noted (November 1 to 15, 1894).

Stone was obtained from the reserve at Pilchers Point (loaded by Government force) and by contract from J. B. & W. L. Killebrew, delivered on barges at Greenville, Miss.

Statement of cost, Lake Providence, La.

Classification of work.	Units.	Pay roll.	Subsistence.	Material.	Total.	Unit of cost, labor.	Unit of cost material.	Total.
Superintendence		$2,441.67	$232.03		$2,673.70			
Woven mat..squares	8,688.4	10,930.80	2,925.60	$25,150.23	39,006.63	$1.824	$2.905	$4.729
Woven mat, pocket, squares	2,219	2,865.40	128.65	5,849.27	8,843.32	1.349	2.636	3.985
Fascine mat..squares	5,654	10,442.08	1,835.70	17,652.53	29,930.31	2.171	3.399	5.570
Fascine mat, shore, squares	248.8	400.95	46.25	668.61	1,115.81	1.797	2.687	4.484
Hydraulic grading, linear feet	4,900	5,847.42	168.70	1,073.50	7,089.62	1.228	.219	1.447
Dressing slope	4,900	2,734.90	351.20		3,086.10			
Paving bank, squares	6,329	4,887.35	576.50	23,054.72	28,518.57	.863	3.643	4.506
Loading stone, cubic yards	28,529.2	6,167.92			6,167.92			
Miscellaneous and property				6,677.11	6,677.11			
Towing		7,662.83	2,153.35	3,148.24	12,964.42			
Total					146,073.51			

Average cost per linear foot, $30.41.

Material per unit of work.

Kind of work.	Quantity.	Brush.	Poles.	Stone.	⅛ wire strand.	¼ wire strand.
	Squares.	*Cords.*	*Cords.*	*Cubic yds.*	*Pounds.*	*Pounds.*
Woven mats	8,688.4	0.96	0.14	1.03	8.09	.....
Fascine mats	5,654	1.37	1.04	1.008	4.14	4.56
Pocket mats	2,219	.97	.14	.92	.....	2.704
Shore connection	248.8	.98	.14	1.03	.....	.....
Bank paving	6,329	.....	.....	2.86	.....	.....
Hydraulic grading, linear feet	4,900	.....	.....	.....	.....	.....
	.....	18,677.5	1,829.8	35,066.7	93,735	31,795
Total per linear foot, fascine	1,805	4.88	.205	7.303	12.96	15.29
Total per linear foot, woven	2,998	3.31	.486	7.303	23.46	1.099

Kind of work.	¼ wire strand.	No. 12 galvanized wire.	Bronze wire.	Spikes.	Staples.	Clips.	Coal.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Bushels.*
Woven mats	.....	7.55	.....	0.59	0.057	.....	.....
Fascine mats	4.59	.97	1.08	.....	.32	2.26	.....
Pocket mats	.....	6.31	.....	.36	.....	.....	.....
Shore connection	.....	7.55	.....	.....	.....	.....	.....
Bank paving	.....	.....	.....	.....	.....	.....	.....
Hydraulic grading, linear feet	.....	.....	.....	.....	.....	.....	2.52
	25,947	86,953	6,114	6,000	2,300	12,778	.....
Total per linear foot, fascine	14.37	6.017	3.38	.17	.997	7.08	.....
Total per linear foot, woven	.....	25.38	.....	1.89	.16	.....	.....

NOTE.—Fascine work includes 853 squares pocket mat, woven plan.

Labor per unit statement.

Kind of work.	Quantity.	Hours applied.	Average.	Hours per foot, completed work.
Woven mats ..... squares	8,688.4	82,224	9.46	27.42
Fascine mats ..... do	5,654	67,440	11.93	37.36
Pocket mats ..... do	2,119	13,627	6.14	.....
Shore connection ..... do	248.8	2,795	11.20	.....
Paving bank ..... do	6,329	39,739	6.28	.....
Hydraulic grading ..... linear feet	4,900	24,855	5.07	.....
Dressing slope ..... do	4,900	22,171	4.52	.....
Total for completed work	.....	252,851	52.6	.....

Average cost of labor per hour, including subsistence, 18.2 cents.

The percentage of cost of the different items was:

Items.	Charge.	Per cent.
Pay roll	$54,381.32	37.9
Subsistence	8,417.98	5.9
Material	76,597.10	53.4
Property and miscellaneous	6,677.11	2.8
Total	146,073.51	100

The percentage of cost of the several kinds of work was:

Kind of work.	Charge.	Per cent.
Superintendence	$2,673.70	1.8
Woven mats	39,006.63	27.9
Fascine mats	29,930.31	20.8
Pocket mats	8,843.32	6.2
Shore mats	1,115.81	.8
Grading bank	7,089.62	4.9
Dressing slope	3,086.10	2.3
Paving bank	28,518.57	19.9
Loading stone	6,167.92	4.5
Towing	12,964.42	9.1
Property and miscellaneous	6,677.11	2.8
Total	146,073.51	100

Detailed statement of expenditures and the cost of the different items of work accompany and form part of this report.

Thanking my assistants, Messrs. W. M. Keller, receiver of material; Martin Christensen, foreman in charge, and E. H. Miles, commissary, for the prompt and conscientious discharge of their duties, I am,

Very respectfully,

GEORGE C. THOMAS,
Superintendent of Construction.

MR. ARTHUR HIDER,
United States Assistant Engineer.

Distribution of time and cost.

Kind of work.	Hours applied.	Pay roll and subsistence.
Superintendence	6,490	$2,673.70
Woven mats:		
Building	34,253	5,854.22
Poling	7,365	1,104.75
Ballasting	8,666	1,299.90
Sinking	3,543	531.45
Line work	15,397	2,309.55
Pocket mats:		
Building	9,386	1,407.90
Poling	1,732	259.80
Ballasting and sinking	1,509	226.35
Fascine mats:		
Building	36,241	5,798.56
Poling	1,977	316.32
Ballasting	4,270	683.20
Sinking	2,422	387.52
Shore, sinking and building	2,795	447.20
Line work	10,530	1,684.80
Steamboats	43,268	9,816.18
Care of fleet and property	21,000	3,150.00
Loading stone	38,004	6,167.92
Paving bank	31,739	4,963.85
Dressing slope	20,171	3,025.65
Grading bank:		
Grader No. 1	12,179	2,644.54
Grader No. 2	10,429	2,530.86
Grader No. 77	2,247	540.72
Clearing bank	403	60.45
Twisting wire	3,661	449.15
Subsistence	26,150	3,204.23
Hospital	5,460	1,260.53
Total	362,287	62,799.30

Began work October 10, 1894; closed March 12, 1895. Number of working days, 138.

Labor employed.

Month.	Number of men.
October	2,298
November	7,089
December	10,907
January	12,343
February	7,522
March	2,270
Total	43,123

Average force per day, 43,123 ÷ 138 = 319 men per day.

Pay roll as per abstract sent in	$54,381.32	
Subsistence as per bills received	8,417.98	
		$62,799.30
MATERIALS.		
3,966 cubic yards stone	5,875.37	
13,855.5 cubic yards stone	16,906.58	
16,383.5 cubic yards stone	18,874.22	
861.5 cubic yards stone	993.57	
		42,649.74
18,677.5 cords brush, at 97½ cents	18,210.56	
1,829.8 cords poles, at $1.75	3,202.15	
		21,412.71
93,735 pounds wire strand, ⅝ inch, at 2.51 cents	2,352.75	
21,947 pounds wire strand, ⅝ inch, at 3.49 cents	765.95	
9,848 pounds wire strand, ⅝ inch, at 2.485 cents	244.72	
25,947 pounds wire strand, ½ inch, at 2.95 cents	765.44	
72,774 pounds galvanized wire, at 1.83 cents	1,331.76	
14,179 pounds galvanized wire, at 2.49 cents	353.06	
5,125 pounds bronzed wire, at 14¾ cents	755.94	
989 pounds bronzed wire, at 15.45 cents	152.80	
6,000 pounds wire spikes, at 2.29 cents	137.40	
500 pounds staples, at 2.25 cents	11.25	
500 pounds staples, at 2.25 cents	11.25	
300 pounds staples, at 2.50 cents	7.50	
1,000 pounds staples, at 1.70 cents	17.00	
150 Magnolia clips, at 7½ cents	11.25	
6,250 Magnolia clips at 7½ cents	468.75	
5,000 Magnolia clips	175.00	
1,378 pounds cable clamps at 3 cents	41.34	
		7,603.16
1,000 bushels coal, at 10 cents	100.00	
4,638.75 bushels coal, at 12 cents	556.65	
312 bushels coal, at 12½ cents	37.50	
1,625 bushels coal, at 13⅛ cents	224.25	
38,771 bushels coal, at 8.6 cents	3,353.34	
		4,271.74
Lumber		397.06
150 yards canvas	16.00	
2 kegs nails	3.20	
Packing	135.17	
8 check and globe valves	13.00	
125 pounds waste	10.08	
Damage to cotton (N. & J.)	7.00	
2 dozen lamp chimneys	1.56	
1 dozen lantern burners	.75	
6½ dozen lantern globes	7.50	
8 dozen lamp chimneys	12.50	
6 dozen lantern burners	2.10	
1 gross lamp wicks	.85	
193½ yards crash	23.77	
4 wrist pins	3.38	
Oakum	10.62	
200 carbons	3.25	

1 pound tripoli	$0.40	
60 feet pipe and fittings	1.85	
50 pounds steel	4.00	
835 pounds iron	23.89	
Telegrams	11.43	
Office rent	88.33	
		$380.63

STATIONERY, BOOKS, ETC.

C. B. Jones, secretary and treasurer	20.00	
Hall & McChesney	5.00	
S. C. Toof & Co	36.50	
A. R. Taylor & Co	38.51	
C. B. Jones, secretary and treasurer	21.00	
D. C. Jones	23.25	
L. L. Gilkey	21.17	
		165.43

MEDICINES.

C. F. Shepherd, secretary and treasurer	69.77	
Do	38.10	
Arthur Hider	17.66	
		125.53
1,366 gallons headlight oil	157.42	
263 gallons signal oil	93.14	
228½ gallons cylinder oil	154.08	
52 gallons valvoline oil	52.00	
87 gallons linseed oil	48.72	
510 pounds white lead	29.98	
55 pounds paint	20.48	
15 gallons turpentine	5.95	
15 gallons lard oil	10.20	
73 gallons black oil	14.72	
		586.68
Value property purchased		5,319.46

TRANSPORTATION.

Harry Lanham, traveling expenses	5.00	
R. C. Newsum, tickets	27.00	
Captain Townsend, mileage	127.66	
G. F. Mosler, agent, transportation	4.00	
J. H. Coffin & Co., agents, transportation	4.95	
John M. Sears, traveling expenses	8.00	
George C. Thomas, traveling expenses	19.00	
J. J. Anderson, traveling expenses	5.00	
W. A. Beamer, transportation	26.00	
H. B. Robinson, transportation	7.50	
R. H. McHie, traveling expenses	20.20	
Arthur Hider, traveling expenses	32.45	
B. S. Anderson, traveling expenses	3.00	
A. D. Coston, traveling expenses	10.25	
J. W. Webb, traveling expenses	15.25	
L. P. Cummings, transportation	15.75	
J. B. Bres, jr., secretary and treasurer, transportation	31.06	
		362.07
Total expenditures		146,073.51

CREDITS.

By material on hand, as per invoice	2,580.37
By subsistence stores, fleet, as per invoice	113.23
By subsistence stores, fleet, as per invoice	46.42
By subsistence stores, survey, as per invoice	17.21
By oils, fleet, as per invoice	49.50
By 328.15 bushels coal (*Vidalia*), as per invoice	28.22
By 600 bushels coal (*Etheridge*), as per invoice	51.60
By 75 bushels coal, grader No. 77, as per invoice	9.00
By 200 bushels coal, grader No. 1, as per invoice	17.20
By 377 bushels coal, steamer *Vedette*, as per invoice	37.70
By 6,500 pounds wire strand, Ashbrook Neck	163.15

By H. A. Tatum, treasurer, staples, not received	$18.75	
By H. A. Tatum, treasurer, wire, not received	1,372.13	
By Jno. A. Leschen, treasurer, strand, not received	2,368.03	
By Jos. D. Bascom, wire, not received	2,290.65	
By W. H. Langdale, treasurer, rope, wire, not received	1,014.40	
By J. H. Coffin & Co., strand, not received	2,056.70	
By L. B. Musgrove, coal, not received	1,506.13	
By L. B. Musgrove, coal, not received	1,292.53	
By J. B. & W. L. Killebrew, stone, not received	8,606.07	
By J. H. Coffin & Co., oil, not received	53.00	
By amount unloading stone, included in cost of stone	748.60	
By pay rolls, Louisiana Bend	1,148.66	
		$25,589.25
Grand total		171,662.76

NOTE.—Articles marked "not received" are articles for which the bills were charged to Lake Providence and only a portion of the goods received at Lake Providence, the rest having been used at Greenville Harbor or Ashbrook Neck or retained on the fleet at Greenville. The cost of what was received was invoiced at Greenville to Lake Providence and is charged up against the work as received from Arthur Hider.

Statement showing linear feet of dikes constructed, Lake Providence Reach, 1881-1886.

System.	Dike built.	Foot mat between dikes.	Foot mat along dikes.	Screens in front dikes.	Wattling between piles.	Shore revetment at ends dikes.	Date.
Duncansby	29,543	9,194	3,610	572	6,422	200	1881-84
Cottonwood	8,527	4,058	4,602	1,487	2,571	120	1884
Mayersville	7,654	2,197	.....	.....	.....	200	1881-84
Baleshead	48,456	18,290	8,335	3,529	4,568	.....	1881-86
Elton	6,140	2,805	.....	.....	.....	.....	1882-83
Stack Island	12,076	11,694	.....	.....	.....	.....	1882-86
Total linear feet	112,396	48,238	16,547	5,588	13,561	520	.....
Total miles	21.29	9.14	3.13	1.06	2.57	.10	.....
Washed out and replaced from time to time as repairs	1.38	.....	.....	.....	.....	.....	.....
Total	19.91	.....	.....	.....	.....	.....	.....

Revetments.

Revetment constructed in front of Mayersville Island, 1881 to 1884 (mats from 125 to 150 feet wide):

	Linear feet.
Length completed revetment	12,578
Length destroyed and replaced	6,648
Total	19,226

Louisiana Bend revetment constructed, 1883 to 1885 (mats from 150 to 175 feet wide):

Length completed revetment	12,500
Length destroyed and replaced	1,750
Total	14,250

Total length of revetment built in Lake Providence Reach, 1881 to 1885:

Louisiana Bend	14,250
Mayersville Island	19,226
Total	33,476

Total miles, 6.34.

APPENDIX 6 B.

Cost of levees in third district, built and enlarged by the United States, from 1882 to May 25, 1895.

MISSISSIPPI.

Year built.	Name of levee.	Built by—	Cubic yards.	Cost, including extra work.	Location on inch-to-mile map.
1882 to May 31, 1894.	Levee construction		4,230,781	$922,621.75	
1882 to May 31, 1894.	High-water protection and engineer expenses.			159,998.12	
1894–95	Eutaw to Mounds	Starling & Smith Co.	178,754	25,383.08	L 433
1894–95	Warfield Point	Hugh McCarten	13,103	1,341.75	L 484
1894–95	Upper Hayes	Ben Talley	116,558	10,490.22	L 553
1894–95	Lower Hayes	do	117,026	10,824.90	L 555
1894–95	Below Australia (Station 0–53).	Timothy Sullivan	146,283	14,262.59	L 367
1894–95	Below Australia (Station 53–124).	do	176,987	16,813.76	L 367
1894–95	Upper Chotard to Brunswick.	L. Aschaffenburg	204,449	24,002.32	L 573
1894–95	Lower Chotard to Brunswick.	James H. Cary	203,955	27,278.95	L 573
1894–95	Buck Ridge	W. L. Withers & Co.	128,615	13,170.18	L 417
1894–95	Ingomar	Hugh McCarten	40,525	4,854.89	L 567
	High-water protection, repairs and engineering expenses to May 1, 1895.			16,085.14	
	Total		5,557,036	1,247,127.65	

ARKANSAS.

1882 to May 31, 1894.	Levee construction		5,769,674.2	1,150,638.39	
1882 to May 31, 1894.	High-water protection, repairs, and engineer expenses.			268,371.31	
1894–95	Boggy Bayou to Gaines Landing—				
	Stations 1320–1385	Timothy Sullivan	109,200	10,374.00	R 445
1894–95	Stations 1385–1460	M. McTighe & Co	112,704	9,850.32	R 446
1894–95	Stations 1460–1518	James Kennedy	128,974	15,542.26	R 449
1894–95	Panther Forest—				R 451–465
	Stations 0–27	The Whitehill Co	173,646	34,295.08	
1894–95	Stations 27–54	do	159,554	28,480.36	R 451–465
1894–95	Stations 54–96	O. B. Crittenden	93,649	10,067.26	R 451–465
1894–95	Sterling to Louisiana line—				R 515–521
	Stations 1038–1140	P. F. Lamb	89,274	8,704.21	
1894–95	Stations 1140–1212	L. C. Dulaney	88,894	10,445.05	R 515–521
1894–95	Arkansas River,* —Sections 1, 2, 3, 4.	Manning & Gibson	177,889	12,407.76	R 401
1894–95	Mathews Bend—				
	Stations 0–30	Robert Johnson	139,774	22,713.28	R 508
1894–95	Stations 30–73	W. J. Bentley & Co	152,271	21,317.94	R 508
1894–95	Stations 73–115	Timothy Sullivan	101,819	10,161.53	R 508
1894–95	Stations 115–162	Robert Johnson	179,609	21,535.12	R 508
1894–95	Lucca Loop	A. P. Martin	46,055	4,835.77	R 428
1894–95	Vaucluse	James Kennedy	56,781	5,110.29	R 486
1894–95	Below Sunnyside	do	82,807	6,748.77	R 492
1894–95	Gorman Ridge, upper*	Timothy Sullivan	244,712	19,799.65	R 512
1894–95	Gorman Ridge, lower*	do	18,420	1,821.92	R 512
1894–95	Grand Lake	do	79,983	9,581.96	R 509
	Cypress Creek,* Stations 275–322.	A. P. Martin	11,888	1,390.90	R 425
	High-water protection, repairs, and engineer expenses to May 1, 1895.			24,552.26	
	Total		8,017,577.2	1,706,745.89	

* Unfinished; retained percentage not included in cost.

Cost of levees in third district, built and enlarged by the United States, etc.—Continued.

LOUISIANA.

Year built.	Name of levee.	Built by—	Cubic yards.	Cost, including extra work.	Location on inch-to-mile map.
1882 to May 31, 1894.	Levee construction		3,128,408.3	637,932.79	
1882 to May 31, 1894.	High-water protection, repairs, and engineer expenses.			145,170.79	
1894–95	Upper Reid*	Robert Nicholson	328,558	47,933.33	R 605
1894–95	Lower Reid*	L. C. Dulaney	142,471.5	17,951.41	R 605
1894–95	Opossum Point	do	41,829.5	4,601.24	R 529
1894–95	Lake Providence	Charles H. Dameron	38,265.2	4,209.17	R 542
1894–95	Otter Bayou to Point Lookout.	Ben Talley	70,800.1	7,717.20	R 547–555
1894–95	Wilton to Salem	do	86,286.6	7,765.79	R 561
	High-water protection and Engineer expenses to May 1, 1895.			6,561.87	
	Total		3,836,619.2	879,843.59	

* Unfinished; retained percentage not included in cost.

Tabulated labor statement of lower Yazoo district.

[Contracts north of Greenville, Miss., between May 1, 1894, and May 1, 1895.]

Name of levee.	Contractor.	Distance from Cairo.	Length.	Duration of contract.	Total teams.	Total scrapers.	Total barrows.	Yards per team.
		Miles.	*Lin. ft.*					
Australia, upper section.	Timothy Sullivan	367	5,300	May 8, 1894, to Sept. 5, 1894.	3,225	2,299	None.	45.36
Australia, lower section.	do	368	7,568	July 11, 1894, to Feb. 19, 1895.	4,611	3,060	None.	38.38
Buck Ridge	W. L. Withers & Co.	415	3,133	June 7, 1894, to Jan. 17, 1895.	3,273	2,428	None.	39.29
Eutaw to Mound Landing.	Starling & Smith Co.	434	27,658	Aug. 1, 1894, to Mar. 9, 1895.	5,405	4,064	1,283	31.05

Name of levee.	Contractor.	Yards per scraper.	Yards per barrow.	Cubic yards in contract.	Price per cubic yard.	Cost per contract.	Length of line abandoned.	Cubic yards of line abandoned.
					Cents.			
Australia—Upper section.	Timothy Sullivan	63.63	None.	146,283	9.75	$14,262.59	.....	.....
Australia—lower section.	do	57.84	None.	176,987	9.50	16,813.76	11,544	180,837
Buck Ridge	W. L. Withers & Co.	52.97	None.	128,615	10.24	13,170.18	2,865	93,690
Eutaw to Mound Landing.	Starling & Smith Co.	41.30	8.5	178,754	14.2	25,383.07	.....	.....

Total cubic yards, 630,639; total cost, $69,629.60.

Tabulated labor statement of lower Yazoo district—Continued.

[Contracts between Greenville, Miss., and Brunswick, Miss., season ending April 1, 1895.]

Name of levee.	Contractor.	Total laborers, all grades.	Days work for each contract.					
			Clearing.		Grubbing.		Sodding.	
			Men.	Teams.	Men.	Teams.	Men.	Teams.
Hays Loop	Ben Talley	7,792	63	5	100	6	106	12
Ingomar Loop	Hugh McCarten	5,011	68	1	80	.....	70	22
Chotard-Brunswick:								
Upper section	L. Aschaffenburg	12,228	911	10	703	.....	99	20
Lower section	James H. Cary	10,905	627	53	838	.....	118	13

Name of levee.	Contractor.	Days work for each contract.				Total cubic yards in contract.	Average cubic yards per day.		
		Slashing.	Teams.	Scrapers.			Laborers.	Barrows	Teams
				Wheel.	Drag.				
Hays Loop	Ben Talley	14	5,256	3,815	38	233,564	30	10	44
Ingomar Loop	Hugh McCarten	13	3,017	1,916	2	101,231	20.2	.....	33.5
Chotard-Brunswick:									
Upper section	L. Aschaffenburg	37	6,787	4,428	13	204,449	16.7	.....	30.1
Lower section	James H. Cary	49	6,026	4,121	5	203,955	18.7	.....	33.8

Name of levee.	Contractor.	Average cubic yards per day.		Average haul of scrapers.		Average height of levee.	Explosives.		Number of stump holes.
		Scrapers.					Dynamite.	Powder.	
		Wheel.	Drag.	Wheel.	Drag.				
				Feet.	*Feet.*	*Feet.*	*Lbs.*	*Lbs.*	
Hays Loop	Ben Talley	61	16	200	200	10.8	.....	.....	70
Ingomar Loop	Hugh McCarten	52.8	.....	165	.....	11.7	520	.....	107
Chotard-Brunswick:									
Upper section	L. Aschaffenburg	46.1	.....	160	.....	11.2	1,700	500	304
Lower section	James H. Cary	49.4	.....	219	.....	12	300	500	429

NOTE.—Stump holes:

Ingomar Loop, cost per cubic yard, where blown out, 8.4 cents; where grubbed, 9.5 cents; average cost of each stump hole, $1.72.

Chotard-Brunswick:

Upper section, cost per cubic yard, where blown out, 10 cents; where grubbed, 10 cents; average cost of each stump hole, $2.21.

Lower section, cost per cubic yard, where blown out, 7 cents; where grubbed, 12 cents; average cost of each stump hole, $3.36.

The explosives were used in clearing pit, very little being used in the actual grubbing of right of way on the Chotard-Brunswick Levee.

Details of distribution of force and material used.

[Boggy Bayou to Gaines Landing Levee, from May 20 to September 30, 1894.]

Inclusive stations.	Number of stations.	Net height.	Average haul.	Embankment.	Muck ditch.	Stump holes.	Total.	Days barrow station men.	Yards per station man per day.
			Feet.	*Yards.*	*Yards.*	*Yards.*	*Yards.*		
1394–1395	2	9.8	100	2,687	.....	.....	2,687	.....	.....
1401–1405	5	10	100	8,539	.....	.....	8,539	.....	.....
1418–1419	2	9.5	120	2,605	.....	.....	2,605	.....	.....
1422–1424	3	10	150	4,148	.....	.....	4,148	.....	.....
1425–1427	3	10.1	160	4,355	.....	.....	4,355	.....	.....
1428–1430	3	9.9	100	4,199	.....	.....	4,199	.....	.....
1431–1434	4	9.7	100	5,698	.....	.....	5,698	.....	.....
1436–1439	4	10.7	100	5,454	.....	.....	5,454	.....	.....
1464–1465	2	11.5	100	3,694	.....	.....	3,694	.....	.....
1467–1468	2	10.9	140	3,277	.....	.....	3,277	.....	.....
1469–1470	2	11.6	150	3,581	.....	.....	3,581	.....	.....
1471–1472	2	10.9	140	3,461	.....	.....	3,461	.....	.....
1473–1474	2	12.2	130	3,128	66	245	3,449	.....	.....
1490–1492	3	13.1	150	6,665	.....	.....	6,665	.....	.....
Enlargement with false berm:									
1503	1	16.7	140	1,359	74	63	1,496	150	9
1504	1	18.4	120	1,256	74	.....	1,330	114	11⅔
1505	1	20.6	130	1,624	74	.....	1,698	194	9
1506	1	19	130	1,558	74	22	1,654	142	12
1507	1	19.3	140	1,396	74	.....	1,470	173	8½

Inclusive stations.	Scrapers.			Yards per scraper per day.	Snatch and plow teams.	Total teams.	Yards per team per day.
	Drag.	Wheel.	Total.				
1394–1395	20½	25½	46	58	13	59½	45
1401–1405	45	115	160	53	64	224	34
1418–1419	10	54	64	41	24	88	30
1422–1424	13	70	83	50	39	122	34
1425–1427	11	78	89	49	43	132	33
1428–1430	9	81	90	47	46	136	31
1431–1434	8	72	80	71	40	120	47
1436–1439	.....	86	86	63	43	129	42
1464–1465	.....	49	49	75	21	70	53
1467–1468	.....	45	45	73	20	65	50
1469–1470	.....	56	56	64	23	79	45
1471–1472	.....	59	59	59	24	83	42
1473–1474	.....	69	69	50	30	99	35
1490–1492	36	95	131	51	42	173	39

Details of distribution of force and material used—Continued.

[Panther Forest Short Line Levee, from May 16, 1894, to April 25, 1895.]

Inclusive stations.	Number of stations.	Dimensions.		Grubbing.							
				Number of trees.							
		Net height.	Average haul.	Over 12 inches.	Under 12 inches.	Total.	Teams grubbing.	Men grubbing.	Explosive used.	Explosives per tree.	Trees per man per day.
									Pounds.	*Pounds.*	
1-2	2	13.6	300	10	17	27	23	70	600	60	¾
3-5	3	14.6	250	24	37	61	7	110	1,325	55	½
6-9	4	15.1	125	25	79	104	.....	.....	1,250	12	.....
10-11	2	15.1	200	13	59	72	.....	70	520	7	1
12-13	2	23.3	300	40	115	155	.....	.....	2,340	15	.....
14-16	3	23.4	300	80	212	292	.....	.....	9,000	31	.....
17	1	21.2	300	15	32	47	6	39	750	16	1¼
18-19	2	21.1	250	13	63	76	.....	.....	1,000	13	.....
20-21	2	21	250	26	36	62	10	130	1,870	30	½
22-24	3	21.2	250	40	82	122	9	61	1,775	21½	2
25-27	3	20.2	200	35	41	76	38	72	1,500	107	1
28-30	3	19.4	200	42	63	105	23	69	1,403	58½	1½
31-33	3	19.8	250	45	21	66	.....	45	975	22	1½
34-36	3	19.4	200	46	24	70	8	82	1,200	17	1
37-39	3	19.6	200	44	12	56	7	94	1,120	20	⅝
40-42	3	19.4	200	37	7	44	5	84	880	20	½
43-45	3	19.7	200	14	17	31	.....	55	450	14½	½
46-49	4	18.5	200	42	13	55	.....	.....	1,260	23	.....
50-51	2	14.8	200	10	12	22	.....	.....	300	14	.....
52-54	3	12	250	5	7	12	.....	.....	150	12½	.....
Spur No. 1	4	13.5	200	.....	.....	.....	.....	.....	.....	.....	.....
Spur No. 2	4	11	100	.....	.....	.....	.....	.....	.....	.....	.....

Inclusive stations.	Embankment construction.													
	Embankment.	Muck ditch.	Stump holes.	Total yards.	Days barrow stations.	Yards per station man per day.	Scrapers.			Yards per scraper per day.	Snatch and plow teams.	Total teams.	Yards per team per day.	Men slashing.
							Drag.	Wheel.	Total.					
	Yards.													
1-2	4,757	133	392	5,282	.....	.....	60	151	231	23	63	294	18	....
3-5	9,451	200	1,659	11,310	.....	.....	6	277	283	40	135	418	27	....
6-9	13,472	267	2,188	15,927	.....	.....	....	499	499	32	209	708	22½	6
10-11	6,808	133	1,161	8,102	.....	.....	....	305	305	26½	115	420	20	4
12-13	14,291	222	4,315	18,828	.....	.....	....	486	486	38½	164	650	29	5
14-16	23,994	333	6,498	30,825	1,178	12½	....	510	510	32	203	713	23	9
17	6,625	111	1,237	7,973	297	16	....	119	119	28	48	167	20	2½
18-19	12,760	222	2,065	15,047	445	9	....	428	428	26	216	644	17½	6
20-21	12,585	222	2,849	15,656	.....	.....	....	249	249	63	138	387	40½	....
22-24	19,028	333	1,267	20,628	.....	.....	....	369	369	56	206	575	36	....
25-27	18,207	200	2,185	20,592	.....	.....	3	636	639	32	198	837	25	....
28-30	16,801	200	3,341	20,342	.....	.....	3	581	584	35	273	857	24	....
31-33	17,108	200	2,818	20,126	.....	.....	....	315	315	64	149	464	43	....
34-36	16,532	200	2,775	19,507	.....	.....	....	505	505	38½	238	743	26	....
37-39	16,661	200	2,943	19,804	.....	.....	....	379	379	52	155	534	37	....
40-42	16,641	200	2,332	19,173	.....	.....	....	361	361	53	145	506	38	....
43-45	16,766	200	1,107	18,073	.....	.....	....	532	532	34	250	782	23	....
46-49	20,331	267	1,616	22,214	1,623	10½	....	364	364	15	132	496	11	12
50-51	7,437	133	469	8,039	.....	.....	....	245	245	32½	115	360	22½	....
52-54	6,643	235	222	7,100	.....	.....	....	172	172	41½	73	245	29	....
Spur No. 1	2,446	.....	.....	2,446	.....	.....	....	82	82	30	32	114	21½	....
Spur No. 2	505	.....	67	5,117	.....	.....	....	108	108	47½	63	171	30	....

Stations 14 to 16: The base to 15 feet below crown, barrow work = 14,421 cubic yards; the balance by scrapers = 16,404 cubic yards.

Station 18: The base to 13 feet below crown, barrow work = 3,945 cubic yards, including muck ditch.

Stations 46 to 49: The base from 8.4 to 11.7 feet above ground, barrow work = 16,806 cubic yards; the balance by scrapers = 5,408 cubic yards.

Details of distribution of force and material used—Continued.

[Panther Forest Short Line Levee, from May 16, 1894, to April 25, 1895.]

Inclusive stations.	Dimensions.			Grubbing.							Embankment construction.			
	Number of stations.	Net height.	Average haul.	Number of trees.			Men grubbing.	Explosives used.	Explosives per tree.	Trees per man per day.	Embankment.	Muck ditch.	Stump holes.	Total
				Over 12 inches.	Under 12 inches.	Total.								
								Lbs.	*Lbs.*		*Yards.*	*Yds.*	*Yds.*	*Yards.*
55–56	2	11.3	175	.....	.....	.....	.....	.....	.....	.....	3,534	.....	.....	3,534
57–58	2	11.6	175	.....	.....	.....	.....	.....	.....	.....	3,896	.....	.....	3,896
59–60	2	10.9	170	.....	.....	.....	.....	.....	.....	.....	3,508	.....	.....	3,508
61–62	2	11.1	125	.....	.....	.....	3	.....	.....	.....	3,433	.....	.....	3,433
63–64	2	11.9	125	.....	.....	.....	4	.....	.....	.....	3,670	.....	.....	3,670
65–66	2	11.8	125	.....	.....	.....	2	.....	.....	.....	3,762	.....	.....	3,762
67–68	2	11.4	125	.....	.....	.....	2	.....	.....	.....	3,687	.....	.....	3,687
69–70	2	11.8	125	2	3	5	6	50	25	1	3,717	.....	146	3,863
71–72	2	11.7	125	2	.....	2	2	.....	.....	1	3,719	.....	.....	3,719
73–75	3	11.7	125	.....	.....	.....	.....	.....	.....	.....	5,726	.....	.....	5,726
76–78	3	11.8	170	.....	.....	.....	.....	.....	.....	.....	5,690	.....	.....	5,690
79–80	2	12.1	170	.....	.....	.....	.....	.....	.....	.....	3,971	.....	.....	3,971
81–82	2	12.2	150	.....	.....	.....	2	.....	.....	.....	4,106	.....	.....	4,106
83–84	2	12.3	150	.....	.....	.....	2	.....	.....	.....	4,148	.....	.....	4,148
85–86	2	12.7	150	.....	.....	.....	3	.....	.....	.....	4,323	.....	.....	4,323
87–88	2	12.7	150	.....	.....	.....	.....	.....	.....	.....	4,460	67	.....	4,527
89–90	2	13	150	16	.....	16	49	.....	.....	.....	4,294	133	241	4,668
91–92	2	12.7	125	8	19	27	36	.....	.....	.....	4,419	133	225	4,772
93–94	2	12.4	140	13	14	27	36	.....	.....	.....	4,209	132	376	4,718
95–96	2	12	200	.....	.....	.....	.....	.....	.....	.....	3,623	108	473	4,204
1–2*	2	4.9	75	.....	.....	.....	.....	.....	.....	.....	1,245	.....	.....	1,245
3*	1	7	100	.....	.....	.....	.....	.....	.....	.....	641	.....	82	723
4–5*	2	7	120	.....	.....	.....	.....	.....	.....	.....	1,965	109	81	2,146
6–7+25*	2½	8	120	.....	.....	.....	.....	.....	.....	.....	3,350	138	82	3,570

Inclusive stations.	Embankment construction.								Sodding.		
	Scrapers.			Yards per scraper per day.	Snatch and plow teams.	Total teams.	Yards per team per day.	Men slashing.	Squares.	Men.	Squares per man per day.
	Drag.	Wheel.	Total.								
55–56	.....	82	82	43	28	110	32	.....	504	7½	67
57–58	.....	64	64	61	30	94	41½	.....			
59–60	.....	65	65	54	45	110	32	.....			
61–62	.....	70	70	49	41	111	31	1	168	2½	67
63–64	.....	61	61	60	33	94	39	.....	168	2½	67
65–66	.....	52	52	72	30	82	46	.....	168	2½	67
67–68	.....	53	53	70	30	83	44	.....	44	1½	67
69–70	2	52	54	71½	32	86	45	.....	.....	.....	.....
71–72	.....	50	50	74	28	78	48	.....	.....	.....	.....
73–75	.....	86	86	66½	48	134	42½	.....			
76–78	.....	114	114	50	57	171	33	.....	420	6½	67
79–80	.....	65	65	61	29	94	42	.....			
81–82	2	51	53	77	30	83	49	.....	168	2½	67
83–84	36	54	90	46	36	126	33	.....	168	2½	67
85–86	28	43	71	61	30	101	43	.....	168	2½	67
87–88	19	67	86	53	36	122	37	.....	.....	.....	.....
89–90	.....	97	97	48	50	147	32	2	.....	.....	.....
91–92	.....	80	80	59½	44	124	38½	5	.....	.....	.....
93–94	5	79	84	56	40	124	38	5	.....	.....	.....
95–96	.....	204	204	20½	98	302	14	3	160	4	40
1–2*	.....	50	50	25	19	69	18	.....	.....	.....	.....
3*	.....	45	45	16	15	60	12	1	30	1	30
4–5*	.....	78	78	27½	36	114	18¾	1½	90	4	22
6–7+25*	.....	140	140	25½	60	200	18	1½	96	5	19

*Spur.

Details of distribution of force and material used—Continued.

[Lucca enlargement levee, from October 26, 1894, to March 15, 1895.]

Inclusive stations.	Number of stations.	Dimensions. Net height.	Average haul.	Embankment.	Muck ditch.	Stump holes.	Total.
		Feet.	*Feet.*	*Yards.*	*Yards.*	*Yards.*	*Yards.*
421–422	2	13.2	160	1,219	146	.....	1,365
423–426	4	14.0	185	3,328	333	14	3,675
427–428	2	13.6	200	1,974	154	32	2,160
429–430	2	14.0	175	1,511	167	2	1,680
431	1	14.0	150	786	83	3	872
432–433	2	14.0	165	1,659	167	8	1,834
434–435	2	14.0	175	1,751	167	6	1,924
436–437	2	14.0	130	1,661	167	6	1,834
438–439	2	14.0	150	1,884	167	.....	2,051
440–443	4	13.5	120	3,366	333	4	3,703
444–447	4	16.5	175	3,900	333	6	4,239
448	1	14.0	160	1,001	83	.....	1,084
449–450	2	16.5	170	2,064	167	.....	2,231
451–452	2	16.0	140	2,032	167	.....	2,199
453–456	3	15.0	140	2,478	250	.....	2,728
456–457	2	15.0	140	1,536	167	.....	1,703
458–459	2	12.5	150	1,634	167	.....	1,801
460	1	12.5	140	731	83	.....	814
461	1	12.5	155	753	83	.....	836
462	1	12.5	160	833	83	.....	916
463–467+50	5½	14.0	165	4,489	438	.....	4,927

Inclusive stations.	Embankment construction. Days wheelbarrow, hired men.	Days wheelbarrow, station men.	Yards per hired man per day.	Yards per station man per day.	Wheel scrapers.	Yards per scraper per day.	Snatch and plow teams.	Total teams.	Yards per team per day.
421–422	.....	.....	.....	.....	32	42.5	15	47	29
423–426	457	.....	8	.....	.....	.....	.....	.....	.....
427–428	.....	.....	.....	.....	70	31	32	102	21
429–430	.....	.....	.....	.....	37	45.5	22	59	28.5
431	88	.....	10	.....	.....	.....	.....	.....	.....
432–433	205	.....	9	.....	.....	.....	.....	.....	.....
434–435	227	.....	8.5	.....	.....	.....	.....	.....	.....
436–437	.....	.....	.....	.....	44	41.75	21	65	28
438–439	.....	.....	.....	.....	85	58.5	16	51	40
440–443	.....	.....	.....	.....	88	42	45	133	28
444–447	.....	.....	.....	.....	92	46	52	144	29.5
448	.....	.....	.....	.....	26	41	13	39	30
449–450	.....	.....	.....	.....	39	57.25	16	55	40.5
451–452	.....	.....	.....	.....	35	63	18	53	41.5
453–455	.....	.....	.....	.....	46	59.25	26	72	38
456–457	.....	.....	.....	.....	37	46	22	59	29
458–459	.....	105	.....	17	.....	.....	.....	.....	.....
460	.....	40	.....	20.25	.....	.....	.....	.....	.....
461	.....	46	.....	18	.....	.....	.....	.....	.....
462	.....	58	.....	16	.....	.....	.....	.....	.....
463–467+50	.....	.....	.....	.....	116	42.5	45	161	30.5

From Station 420+25 to 467+50 the number of squares of levee sodded was 2,717; number of men employed being 36, and number of squares per man per day 75.5.

There was practically no grubbing to be done on this levee, and slashing was very light, there being not a dozen trees that would measure 12 inches at butt.

Tabulated labor statement, Upper Tensas district, Chicot County, Ark.

[Contracts between Luna, Ark., and Louisiana State line, season ending April 1, 1895.]

Name of levee.	Contractor.	Total laborers, all grades.	Days work for each contract.						
			Clearing.		Grubbing.		Sodding.		Slashing.
			Men.	Teams.	Men.	Teams.	Men.	Teams.	
Vaucluse	James Kennedy	2,374	67	.....	60	.....	56	4	.....
Sunnyside	do	2,005	184	5	101	5	55	5	17
Mathews Bend:									
First section	Robt. Johnson	8,281	747	109	1,748	137	63	20	51
Second section	Bentley & Co	9,117	603	75	538	32	110	15	75
Third section	Tim Sullivan	5,304	321	35	540	43	74	12	28
Fourth section	Robt. Johnson	11,404	732	102	2,548	93	88	13	85
Grand Lake	Tim Sullivan	5,382	79	9	310	.....	63	6	13
Grand Lake to Sterling, upper section.	do	8,409	585	84	221	.....	9	3	4
Sterling:									
Upper section	P. F. Lamb	4,194	95	20	154	9	58	12	55
Lower section	L. C. Dulaney	5,385	330	48	386	4	69	52	129

Name of levee.	Contractor.	Days work for each contract.		Scrapers.		Total cubic yards in contract (in place).	Average cubic yards per day.		
		Barrows.	Teams.	Wheel.	Drag.		Laborers.	Barrows.	Teams.
Vaucluse	James Kennedy	.....	1,536	983	.....	44,444	18.7	.....	28.9
Sunnyside	do	.....	1,744	1,285	.....	63,261	21.9	.....	36.3
Mathews Bend:									
First section	Robt. Johnson	.....	4,296	2,694	118	139,774	17	.....	33
Second section	Bentley & Co	.....	5,679	3,702	44	152,271	17	.....	27
Third section	Tim Sullivan	529	2,808	1,870	88	101,819	19	11	34
Fourth section	Robt. Johnson	.....	5,849	3,787	152	179,609	16	.....	31
Grand Lake	Tim Sullivan	993	2,433	1,046	873	79,983	9.5	9.5	30
Grand Lake to Sterling, upper section.	do	.....	5,552	4,062	.....	199,441	24	.....	36
Sterling:									
Upper section	P. F. Lamb	.....	2,476	1,775	40	89,244	21	.....	36
Lower section	L. C. Dulaney	166	2,864	1,881	50	88,894	16	14	30

Name of levee.	Contractor.	Average cubic yards per day.		Average haul in feet.			Average height of levee.	Explosives.		Number stump holes.
		Scrapers.		Wheelbarrows.	Scrapers.			Dynamite.	Powder.	
		Wheel.	Drag.		Wheel.	Drag.				
								Lbs.	*Lbs.*	
Vaucluse	James Kennedy	45.2	....	.....	150	.....	10.1	.....	.....	24
Sunnyside	do	49.2	....	.....	140	.....	7.6	50	300	50
Mathews Bend:										
First section	Robt. Johnson	51	30	.....	325	50	16	6,313	9,273	457
Second second	Bentley & Co	41	30	.....	300	50	14	4,900	5,900	317
Third section	Tim Sullivan	50	30	.....	200	50	13	2,732	2,000	339
Fourth section	Robt. Johnson	46	35	200	250	40	14	5,280	6,700	1,479
Grand Lake	Tim Sullivan	30	34	100	300	100	12	400	400	326
Grand Lake to Sterling, upper section.	do	49	....	.....	150	.....	10	500	2,000	296
Sterling:										
Upper section	P. F. Lamb	50	30	.....	150	30	10	210	900	85
Lower section	L. C. Dulaney	45	30	150	200	50	14	471	3,214	463

GENERAL REMARKS.—The average cost per pound for explosives was: Powder, 11 cents; dynamite, 14 cents.

Tabulated labor statement, Upper Tensas district, Chicot County, Ark.—Continued.

The average cost per stump hole, including cost of explosive and pay of labor and teams, was:

	Per stump hole.	Per cubic yard.
		Cents.
Mathews Bend Levee:		
First section	$7.65	12.9
Second section	5.69	16.8
Third section	3.56	12
Fourth section	2.45	19.3
Grand Lake enlargement	.83	5.5
Grand Lake to Sterling, upper section	1.69	9.7
Sterling:		
Upper section	3.53	16.2
Lower section	1.60	11.4
Sunnyside extension	3.20	16.6

List of civilian engineers employed on work of river and harbor improvement in charge of Capt. C. McD. Townsend, Corps of Engineers, from May 31, 1894, to May 31, 1895, inclusive, under the acts approved March 3, 1893, August 18, 1894, and March 2, 1895.

Name and residence.	Time employed, months.	Compensation per month.	Where employed.	Work on which employed.
Arthur Hider, Greenville, Miss.	12	$250.00	Greenville, Miss ..	Care and repairs to plant; construction work at Lake Providence, La., Greenville, Miss., and Ashbrook Neck.
E. C. Tollinger, Greenville, Miss.	12	175.00	.....do	Construction and repair of levees in Mississippi south of Greenville and in Arkansas south of Greenville to Louisiana line.
H. St. L. Coppée, Greenville, Miss.	12	175.00	Arkansas City, Ark., and Greenville, Miss.	Construction and repair of levees in Arkansas north of Greenville, Miss.
John J. Hoopes, Red Fork, Ark.	12	150.00	Red Fork, Ark....	Construction and repair of levees on Arkansas River.
J. D. Van Meter, Greenville, Miss.	12	150.00	Rosedale, Miss., and Greenville, Miss.	Construction and repair of levees in Mississippi north of Greenville.
W. S. Brown, Lake Providence, La.	12	150.00	Lake Providence, La.	Construction and repair of levees in Louisiana, third district.

Approximate value of plant belonging to the United States and used in the third district improving Mississippi River, May 1, 1894, to April 30, 1895.

Class of property.	Pieces.	Approximate value.	Class of property.	Pieces.	Approximate value.
Steamer Emma Etheridge	1	$7,200	Floating dock	1	$14,580
Steamer Osceola	1	6,300	Pontoon dock	2	500
Steamer Vidalia	1	5,400	Pile drivers and machinery	5	3,717
Steamer Vedette	1	3,600	Skiffs	21	105
Steamer Meter	1	2,700	Yawls	3	.....
Tug Parker	1	4,500	Dredge boat Menge	1	5,000
Mat boats Nos. 26 and 27	2	9,000	Dump scow No. 2	1	1,900
Mat boats (old)	3	1,000	Stern dock	1	225
Headquarters boat	1	1,500	Calking flats	3	100
Quarter boats and outfit	13	25,640	Tools and appliances	.....	800
Store boat	1	225	Office furniture, safe, etc	.....	250
Hydraulic graders	2	16,000	Surveying instruments	.....	2,000
Hydraulic graders (small)	1	900	Machine shop and outfit	1	2,000
Barges, model	9	12,150	Carpenter shop and outfit	1	3,600
Barges, square	11	30,800			
Barges, square (old)	46	69,000	Total	135	230,692

Abstract of proposals for levee work in Upper Tensas levee district for the fiscal year ending June 30, 1896, received and opened by Capt. C. McD. Townsend, Corps of Engineers, November 16, 1894.

No.	Name of bidder.	At mounds on Cypress Creek.	
		Station 0–51.	Station 51–98.
		Cents.	*Cents.*
1	A. A. Arnold & Co	12⅛	12⅜
2	T. S. Aderholdt	12.24	12.49
3	John Scott & Sons	12	12.43
4	M. McTighe	13.27	13.74
6	Ben Talley	12.90	12
7	Timothy Sullivan	14.90	15.99
8	McGuire & O'Donnell	13	12.44
9	L. C. Dulaney	11.88	12.84
10	McLaughlin Bros	12.99	12.99
11	J. C. Hodge	18	18
12	P. F. Lamb	14.35	13.95
13	Leopold Aschaffenburg	18	16
14	Batt O'Brien	14.95	15.95
15	W. A. Shippey	13	11.90
16	A. P. Martin	.....	15
17	J. C. McIntyre & Co	11.90	12.37
18	Chas. Dameron	14	13.50
19	The Whitehill Co	12.74	11.73
20	C. A. Winter	12.89	13.83
21	Robert Johnson	13.74	12.99

Abstract of proposals for construction and enlargement of levees in Upper Tensas levee district, in Arkansas, for the fiscal years ending June 30, 1895, and June 30, 1896, received and opened by Capt. C. McD. Townsend, Corps of Engineers, September 25, 1894.

No.	Name of bidder.	On Cypress Creek.		Lucca Loop, Station 420–468.	Vaucluse, Station 388–421.	Below Sunnyside, Station 685–791.	Grand Lake.	Gorman Ridge.	
		Station 222–274.	Station 275–322.					Upper section.	Lower section.
		Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1	Leopold Aschaffenburg	15.74	17.98	.....	.....	.....	.....	11.73	23.23
2	James H. McTighe	25	25	.....	13.74	10.24	.....	16.98	19.98
3	Arnold, DeGaris & Co	19⅜	21⅛	16⅝	12⅜	11⅞	21⅛	14⅜	19⅜
4	Robert Johnson	17⅛	18⅛	21	11.74	10.24	13.24	10.49	19.24
5	L. C. Dulaney	13.89	14.70	14.21	13	8.79	14.74	9.24	14.93
6	The Whitehill Co	14.95	15.75	13	12	13	14½	15	17
7	John A. Cannon	14.25	15	14	14.24	9.74	14.49	9.74	16.74
8	C. A. Winter	14.74	.....	18	.....	10½	.....	.....	.....
9	W. L. Withers & Co	.....	.....	.....	13	11⅛	.....	11.85	22
10	T. Mike	.....	.....	.....	.....	8.80	.....	.....	.....
11	Charles O'Donnel	13½	14	18	9.60	9.90	.....	.....	.....
12	A. P. Martin	13	13	10½	.....	.....	.....	.....	.....
13	John Scott & Sons	12.93	13.93	22	11.93	9.70	22	9.70	15.45
14	James Austin	.....	.....	.....	.....	9.94	.....	.....	.....
15	James Kennedy	.....	16	.....	9	8.15	.....	.....	.....
16	Starling & Smith Co	.....	16.97	.....	11¼	.....	.....	.....	.....
17	P. F. Lamb	.....	.....	18½	15	12.24	17	15⅜	17⅛
18	John G. Sessions	16.70	17.23	15.97	11.73	10.73	.....	9.98	14
19	Ben Talley	18	18	.....	12⅜	12⅛	.....	12½	28
20	Manning & Gibson	25	25	.....	11.74	9.70	15	11.94	.....
21	Charles H. Dameron	.....	.....	.....	14	9½	16	11	17½
22	Terrell & Watkins	17.24	.....	.....	.....	.....	.....	.....	.....
23	Tim Sullivan	17¾	17¾	16⅞	11¼	10.99	11.98	8.99	10.99

Abstract of proposals for levee work in Middle Tensas levee district for the fiscal year ending June 30, 1895, received and opened by Capt. C. McD. Townsend, Corps of Engineers, November 16, 1894.

No.	Name of bidder.	Opossum Point, Station 755–851.	Lake Providence, Station 1459–1487, 1496–1501, 1519–1576.	Otter Bayou to Point Lookout, Station 1840–1986.	Wilton to Salem, Station 2287–2528.
		Cents.	*Cents.*	*Cents.*	*Cents.*
2	A. A. Arnold & Co	15.45	12⅜	16	11½
3	John Scott & Sons	15.45	15	12.24	11.73
4	M. McTighe	18	20	18	20
5	Eltringham Construction Co	.....	12.73	.....	12.73
6	Ben Talley	11.24	12	10.90	*9
8	McGuire & O'Donnell	12.97	11.47	13.49	12.47
9	L. C. Duianey	11	13½	15	16
11	J. C. Hodge	14.74	12.73	14.99	12.99
12	John Burke	.....	16.95	.....	.....
14	Leopold Aschaffenburg	.....	.....	13.97	13.74
18	J. C. McIntyre & Co	21	17	20	17½
19	Chas. Dameron	12⅜	11	11½	*9

* Tie bids; awarded to Ben Talley by mutual agreement between the two bidders.

Financial statement.

LAKE PROVIDENCE REACH.

Balance May 31, 1894	$6,554.09
Allotted during current fiscal year	304,400.00
Received from sales, overpayments, and refundments	4.76
	310,958.85
Expended to June 30, 1895	127,428.34
Balance June 30, 1895	183,530.51
In Treasury	164,400.00
In hand	19,130.51
	183,530.51
Less amount covered by existing contracts and liabilities	13,530.51
Available balance June 30, 1895	170,000.00
Expenditures apportioned:	
Labor on construction	41,487.07
Material for construction	42,751.51
Subsistence	12,190.65
Cost of plant, repairs, outfits, and supplies	8,777.86
Care of public property	2,741.91
Towage and steamer expenses	12,360.02
Administration and office expenses	6,407.28
Medicine and medical attendance	712.04
Total	127,428.34
Amount that can be profitably expended during fiscal year ending June 30, 1897	300,000.00

VICKSBURG, MISS.

Balance May 31, 1894	$108.07
Balance June 30, 1895	108.07
In hand	108.07
Amount covered by existing contracts and liabilities	108.07

LAKE BOLIVAR FRONT.

Balance May 31, 1894	$104.38
Balance June 30, 1895	104.38
In hand	104.38
Amount covered by existing contracts and liabilities	104.38

ASHBROOK NECK.

ng current fiscal year	$35,000.00
June 30, 1895	49,109.72
e June 30, 1895	35,890.28
	25,000.00
	10,890.28
	35,890.28
covered by existing contracts and liabilities	1,660.38
ble balance June 30, 1895	34,229.90
s apportioned:	
construction	10,765.16
for construction	23,041.39
lant, repairs, outfit, and supplies	289.81
ublic property	451.50
and steamer expenses	7,768.28
ration and office expenses	2,814.00
and medical attendance	341.67
	3,637.91
	49,109.72

PLANT.

31, 1894	$30,359.05
ng current fiscal year	125,000.00
	155,359.05
ne 30, 1895	100,472.38
e June 30, 1895	54,886.67
	66,000.00
overdrawn	11,113.33
	54,886.67
es	4,886.67
ble balance June 30, 1895	50,000.00
s apportioned:	
repairs	32,574.60
for repairs	12,069.70
lant, outfit, and supplies	24,867.88
lant	11,741.75
ration and office expenses	4,846.99
ice	14,371.46
	100,472.38
can be profitably expended during fiscal year ending June	100,000.00

SURVEYS, GAUGES, AND OBSERVATIONS.

31, 1894	$5,290.83
ng current fiscal year	18,000.00
	23,290.83
June 30, 1895	7,246.35
e June 30, 1895	16,044.48
	16,000.00
	44.48
	16,044.48
es	1,200.00
ble balance June 30, 1895	14,844.48

Expenditures apportioned:		
Surveys		$5,296.99
Steamer expenses		1,121.84
Outfit, material, and stationery		379.89
Subsistence		447.63
Total		7,246.35
Amount that can be profitably expended during fiscal year ending June 30, 1897		12,000.00

LOWER YAZOO LEVEE DISTRICT.

Balance May 31, 1894	$12,784.77	
Allotted during current fiscal year	300,000.00	
		$312,784.77
Expended to June 30, 1895	166,474.08	
Loss by transfer during current fiscal year	3,000.00	
		169,474.08
Balance June 30, 1895		143,310.69
In Treasury		147,000.00
Less amount overdrawn		3,689.31
		143,310.69
Less amount covered by existing contracts and liabilities		113,310.69
Available balance June 30, 1895		30,000.00
Expenditures apportioned:		
Levee construction and repairs		150,548.89
Engineering and office expenses		15,925.19
		166,474.08
Amount that can be profitably expended during fiscal year ending June 30, 1897		400,000.00

UPPER TENSAS LEVEE DISTRICT.

Balance May 31, 1894	$13,177.32	
Allotted during current fiscal year	600,000.00	
Received from sales, overpayments, and refundments	8.16	
		$613,185.48
Expended to June 30, 1895	315,171.48	
Loss by transfer during current fiscal year	6,000.00	
		321,171.48
Balance June 30, 1895		292,014.00
In Treasury		294,000.00
Less amount overdrawn		1,985.00
		292,014.00
Less amount covered by existing contracts and liabilities		222,000.00
Available balance June 30, 1895		70,000.00
Expenditures apportioned:		
Levee construction and repairs		289,062.40
Engineering and office expenses		26,108.08
		315,171.48
Amount that can be profitably expended during fiscal year ending June 30, 1897		200,000.00

MIDDLE TENSAS LEVEE DISTRICT.

Balance May 31, 1894	$1,168.41	
Allotted during current fiscal year	200,000.00	
Gained by transfer during current fiscal year	105,000.00	
		$306,168.41

Expended to June 30, 1895	$102,869.22	
Loss by transfer during current fiscal year	2,000.00	
		$104,869.22
		201,299.19
In Treasury		178,000.00
In hand		23,299.19
		201,299.19
Less amount covered by existing contracts and liabilities		151,299.19
Available balance June 30, 1895		50,000.00
Expenditures apportioned:		
Levee construction and repairs		95,553.40
Engineering and office expenses		7,315.82
		102,869.22
Amount that can be profitably expended during fiscal year ending June 30, 1897		200,000.00

IMPROVING HARBOR AT VICKSBURG, MISS.

Balance May 31, 1894	$11,053.74
Expended to June 30, 1895	4,255.61
Balance June 30, 1895	6,798.13
In hand	6,798.13
Available balance June 30, 1895	6,798.13
Expenditures apportioned:	
Cost of plant, repairs, and outfit	1,341.35
Care of plant	434.49
Towage and steamer expenses	365.92
Administration and office expenses	1,962.45
Subsistence	151.40
Total	4,255.61
Amount that can be profitably expended during fiscal year ending June 30, 1897, at Delta Point	150,000.00

IMPROVING HARBOR AT GREENVILLE, MISS.

Balance May 31, 1894		$2,249.66
Allotted during current fiscal year		80,000.00
		82,249.66
Expended to June 30, 1895		79,814.74
Balance June 30, 1895		2,434.92
In Treasury		5,000.00
Less amount overdrawn		3,565.08
		2,434.92
Less amount covered by existing contracts and liabilities		2,434.92
Expenditures apportioned:		
Labor on construction		19,446.71
Material for construction		39,824.96
Cost of plant, repairs, outfit, and supplies		4,365.84
Care of public property		855.33
Towage and steamer expenses		5,653.41
Medicine and medical attendance		312.22
Subsistence		6,755.02
Administration and office expenses		2,601.25
Total		79,814.74
Amount that can be profitably expended during fiscal year ending June 30, 1897		150,000.00

STONE.

Balance May 31, 1894	$
Allotted during current fiscal year	
	1
Expended to June 30, 1895	
Balance June 30, 1895	
In Treasury	
In hand	
Less amount covered by existing contracts and liabilities	
Expenditures apportioned:	
Stone	
Towing and steamer expenses	
Cost of plant, repairs, outfit, and supplies	
Care of public property	
Administration and office expenses	
Subsistence	
Total	

APPENDIX 7.

REPORT OF CAPT. GEO. M'C. DERBY, CORPS OF ENGINEERS, UPON OPERATION FOURTH DISTRICT.

UNITED STATES ENGINEER OFFI
New Orleans, La., May 2

SIR: I have the honor to submit the following report upon the work of t district, Mississippi River improvement, for the period from June 1, 1894, t 1894:

Until October 31, 1894, the district was in charge of Capt. John Millis that date until November 23, 1894, it was in temporary charge of Maj. Quinn, Corps of Engineers.

Pursuant to the requirements of Special Orders, No. 255, Adjutant-Genera dated Washington, October 30, 1894, I relieved Major Quinn of this work N 23, 1894.

The district extends from Warrenton, 7½ miles below Vicksburg, to the the Passes, about 13 miles from the Gulf of Mexico, and comprises 484 mil river.

The works include improvements of the harbor of Natchez and Vidalia, M and Louisiana; channel improvements at the junction of the Mississippi, Atchafalaya rivers; improvement of the harbor of New Orleans, and the tion, repair, and maintenance of a portion of the levee system of the distri

HARBOR OF NATCHEZ AND VIDALIA.

The rapid caving of the bank in Giles Bend, above Natchez, has narr adjacent neck so that there is danger that the river may break through in hi and form a permanent cut-off. Should such cut-off take place, it is apprehe the river may change its course below by rapid erosion on the west banl panied by accretion on the east bank. This would result in the destruc portion or all of the town of Vidalia, injury to the water front and lar Natchez, and increased caving of the banks, with consequent destruction sive parts of the levee system.

The object of the contemplated works is to delay, and if possible pre formation of the threatened cut-off. The project for this work contemp construction of a levee on or near the axis of Cowpen Neck to prevent th water across the neck during high stages of the river, and the construction linear feet of bank revetment in Giles Bend; estimated cost, $541,300.

By the river and harbor act of July 13, 1892, an appropriation of $80,000 for this work, of which $77,721.19 remained available June 1, 1894, and t August 17, 1894, appropriated an additional $80,000.

Legal proceedings for the condemnation of the land necessary for the con of the levee on Cowpen Neck, which were in progress at date of last rep

completed September 15, 1894, and title secured to the United States at a cost of $3,500. Contracts for the construction of the levee were made October 5, 1894, excepting the brush revetment at the outer end and the short spur levee designed to arrest erosion in the event of the main line being breached by the caving of the bank. The last contract was completed February 26, 1895; the total cost of the 267,810 cubic yards of earthwork was $29,275.47.

The brush revetment at the outer end was constructed by hired labor at a cost of $2,508.38, making the total cost of the levee, 19,500 feet long, including cost of site, $35,283.85. As the soil is very sandy the levee has been much damaged by rain wash; repairs have already been made to it to the amount of $1,175.35.

The spur levee was not constructed at the same time as the main line because it did not seem to be immediately required, and there were indications that changes in the rate of caving of the bank might make it advisable to construct this spur levee at some point other than the one originally selected.

The proposed drainage syphons have not yet been placed.

A map showing the levee as constructed is transmitted herewith.

No work has as yet been done on the proposed bank revetment in Giles Bend. A survey is now in progress to determine the proper location of this revetment and contracts have been made for the construction of ten decked barges and the delivery of 12,000 tons of rock, preparatory to beginning work. The price of the barges is to be $30,940 delivered at Natchez, Miss., and the rock is to be delivered on shore at some convenient point in Giles Bend for $1.64 per ton of 2,000 pounds.

For further details of the work accomplished during the year reference is made to the report of Mr. H. S. Douglas, assistant engineer, herewith.

The caving in Giles Bend and Marengo Bend still continues at a rapid rate, as shown on the accompanying chart. If it is allowed to continue, the cut-off will not only do all the damage to Natchez and Vidalia which was originally anticipated, but the new levee on Cowpen Neck will be destroyed and the amount which it has cost, $36,459.20, will be wasted. If it is intended to prevent this cut-off, prompt and energetic measures are necessary.

The amount which can be profitably expended on this work during the fiscal year ending June 30, 1897, is $385,000.

IMPROVING HARBORS AT NATCHEZ AND VIDALIA, MISS. AND LA.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $45,772.18, distributed as follows:

Office expenses (main office)		$2,349.86
Other administrative expenses		3,042.40
Construction (contract work)		29,500.12
Construction (hired labor):		
Wages	$1,834.88	
Subsistence	1,383.65	
Material	193.26	
		3,411.79
Steamers		1,914.28
Surveys		1,244.78
Repairs to plant		16.85
Care of plant		502.19
New plant		289.91
Miscellaneous		3,500.00
Total		45,772.18

Money statement.

June 1, 1894, balance unexpended	$71,721.19
Amount appropriated by act of August 17, 1894	80,000.00
	157,721.19
Amount expended from June 1, 1894, to June 30, 1895	45,772.18
July 1, 1895, balance unexpended	111,949.01
July 1, 1895, amount covered by uncompleted contracts	46,600.92
July 1, 1895, balance available	65,348.09
Amount (estimated) required for completion of existing project	385,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1897	385,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

JUNCTION OF THE MISSISSIPPI, RED, AND ATCHAFALAYA RIVERS, LOUISIANA.

A detailed description of the difficulties in this vicinity, which the improvements are designed to rectify, will be found in the annual report of 1892. In general terms these difficulties consist in the filling up of Old River, which is the only navigable entrance from the Mississippi to the Red and Atchafalaya rivers and their tributaries, so that low-water navigation is impeded and at times entirely obstructed.

This filling up is attributable in part to the deposit of sediment during high water caused by irregular variations in the strength and direction of the current in Old River and in part to the caving in, or sliding down, of the soft banks adjacent to the channel.

The complete system of works contemplated with a view to correcting these difficulties comprises the following objects:

To check the enlargement of the Atchafalaya and limit its outlet capacity by a system of low relief dams or sills located near the head of this outlet river.

To separate the Red from the Atchafalaya during low water and up to a 10-foot stage by means of a low dam at the west end of Turnbull Island, which for all stages below the crest of the dam would deflect the Red around the upper side of Turnbull Island through upper Old River.

To complete the separation by cutting a canal across Carrs Point and obstructing the lower end of upper Old River, thus making the Red a tributary and the Atchafalaya an outlet, separated from each other at low stages, while the conditions at high stages are not to be materially modified.

The plan also contemplates maintaining low-water navigation through lower Old River, if practicable, by dredging or otherwise, pending the completion of the above system of works.

The entire Red and Atchafalaya system, whose only outlet is now through the channels which these works are designed to improve and maintain, comprises a total length of about 4,300 miles of navigable river in those stages in which there are at present no difficulties in lower Old River. In low water when such difficulties are experienced the navigable portion of the Red and Atchafalaya system is about 345 miles for a 3-foot draft and 132 miles for a 5-foot draft.

At the date of the last annual report the following works had been done:

Two sill dams near the head of the Atchafalaya, with the shore protection, connecting levees, and wing levees, had been completed. The sill or foot mattresses and shore protection work of the Red River Dam had been finished and the dam constructed to a height of 3 feet above the zero of Barbre's gauge, excepting a length of 450 feet for the accommodation of low-water navigation, which was 5 feet below the zero of Barbre's gauge. A new dredge boat had been built under contract and had been tested and accepted.

The operations during the current year have consisted in dredging lower Old River, making repairs to Red River Dam and the sills in the Atchafalaya, making extended survey of the mouth of Red River and vicinity, and clearing out stumps and trees in Bayou des Glaises.

The new pumping dredge *Ram* was put to work on June 5, 1894, and the bucket dredge *Pah-Ute* on July 28, 1894, and they continued dredging until January 4, 1895 It is roughly estimated that the former dredged 265,000 cubic yards, at a cost of 4.76 cents per cubic yard, and the latter 50,000 cubic yards, at 6.85 cents per cubic yard. The material dredged was deposited in the stream alongside the cut made by the dredges.

The lowest reading of the gauge at Barbres Landing was 1.61 feet below zero on November 12, 1894, the lowest on record. The least channel depth in Old River reported was 4½ feet. This was sufficient for the light-draft boats which were able to navigate the rivers having their outlets through lower Old River, and navigation through lower Old River was, therefore, maintained during the low-water season without interruption. This result cost $19,304.29.

The repairs made to the dam and sills were not extensive, costing $450.87 and $111.50, respectively.

The survey made during the year covers the same area as those made in 1884 and 1887 at the junction of the Atchafalaya and Red rivers and in upper and lower Old River. The field work of the survey cost $7,360.25; the maps have not yet been completed.

The river and harbor act of August 17, 1894, provided that $2,500 of the $70,000 appropriated for the Red and Atchafalaya rivers, might be expended in improving Bayou des Glaises, Louisiana. A report upon this stream will be found in the Annual Report of the Chief of Engineers for 1880, page 1176. The funds have been expended in cutting overhanging trees and blasting out the stumps in the bed of the bayou; a balance of $392.90 still remains available. Operations were confined to the lower 39.25 miles of the stream.

For further details of the work accomplished during the year reference is made to the report of Mr. A. F. Woolley, jr., assistant engineer, herewith.

IMPROVING ATCHAFALAYA AND RED RIVERS, LOUISIANA.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $42,292.67, distributed as follows:

Office expenses (main office)	$1,197.35
Other administrative expenses	237.73
Maintaining navigable channel through lower Old River	19,706.49
Improving Bayou des Glaises	2,107.10
Repair to sill dams	111.50
Repair to Red River dam	450.87
Repair and maintenance of telephone line	345.76
Surveys	8,128.79
Steamers	727.38
Repairs to plant	6,270.04
Care of plant	1,743.03
New plant	766.63
Total	42,292.67

Money statement.

June 1, 1894, balance unexpended	$43,298.79
Amount appropriated by act of August 17, 1894	70,000.00
Balance available	113,298.79
Amount expended from June 1, 1894, to June 30, 1895	42,292.67
July 1, 1895, balance unexpended	71,006.12
Amount that can be profitably expended in fiscal year ending June 30, 1897 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	300,000.00

NEW ORLEANS HARBOR.

The general object of the works of improvement in New Orleans Harbor is to check, and, if possible, to prevent the caving of the banks of the river within the limits of the harbor.

Under the approved project the work to accomplish these objects consists in the construction of submerged inclined spur dikes, with continuous revetments between these dikes when found necessary.

Spur dikes without intermediate revetment have been successful in some of the straight reaches and on concave banks of large radius, but in the abrupt bends the dikes alone are only locally effective.

At the date of the last annual report the following work had been completed in general accordance with the project as above outlined. A continuous mattress 400 feet in length had been placed just above the caving bank in the Carrollton Bend. Five spur dikes, with continuous revetment covering the three upper intervals and somewhat more than one-third of the lower one, had been built in the Carrollton Bend, two spur dikes in the Greenville Bend, six in the Gouldsboro Bend, and eight in the third district reach.

All of the above work remains in place and has proved successful, with the following exceptions: In the third district reach no further caving has taken place at the heads of the dikes, but caving has continued, more or less serious in extent, in the intervals between the dikes, and there has been no noticeable accretion. In the Gouldsboro Bend a small cave occurred between Dikes 3 and 4, but otherwise the bank line remained unchanged. Destructive caving has also taken place along the water front between Carrollton and Exposition Wharf, at Eighth street, at the Soraparu Market, in the bend at and below the French Market, and at Algiers Point. No protection work has been done at these localities by the United States, but the city of New Orleans has constructed pile work and wooden bulkheads with a view to arresting the caving near the French Market, at Algiers Point, and in the intervals between the third district spur dikes. This work has been partially successful, except in the third district reach.

At the date of the last annual report there were no funds available for this work, not even for the care of the extensive and costly plant on hand. In this connection it is to be observed that floating plant, consisting of wooden barges and steamboats,

deteriorates very rapidly in this climate; and this action goes on just as rapidly when the plant is idle as when it is at work. There are other heavy expenses, for watchmen and superintendence, that can not be avoided when the plant is idle; so that the cost of the work done in New Orleans Harbor, is greatly increased by the irregularity and inadequacy of the appropriations.

The act of August 17, 1894, appropriated $110,000 for this improvement, a large proportion of which, amounting to $14,977.28, had to be expended in making repairs to plant.

Mattress work was begun in the third district late in the season and was suspended March 12, 1895, in anticipation of high water in the river; 744,000 square feet of mattress 2½ feet thick was constructed and sunk at a field cost of 8.14 cents per square foot.

In compliance with resolutions of the Mississippi River Commission, dated August 29 and November 20, 1894, a continuous mattress revetment was placed from Spur No. 1 to Spur No. 2, a distance of 1,020 feet; the foundation mattresses were laid for new spurs to be numbered 2½, 3½, 4, and 4½: and a mattress 200 feet wide has been placed below Spurs No. 2, 3, 3½, 4, and 4½ adjoining the foundation mattress at its shore end.

The location of the new work is shown on the accompanying map.

The balance remaining on hand is not sufficient to complete the spurs which have already been begun; to secure economy in the management of this work regular appropriations of not less than $200,000 per annum are necessary.

For details of construction reference is made to the accompanying report of Assistant Engineer William Garvin.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $93,873.09, distributed as follows:

Office expenses (main office)	$911.37
Other administrative expenses	3,020.38
Labor on construction	17,672.11
Subsistence	7,548.82
Material for construction	32,646.08
Steamers	6,496.75
Surveys	484.55
Repairs to plant	15,381.36
Care of plant	7,780.54
New plant	1,925.63
Miscellaneous	5.50
Total	93,873.09

Money statement.

Amount appropriated by act of August 17, 1894		$110,000.00
Amount disallowed by Chief of Engineers (overpayment)		6.33
Amount disallowed by Chief of Engineers (overpayment)		1.67
Amount received from sale of engineer property		38.63
Total		110,046.63
Amount expended from June 1, 1894, to June 30, 1895	$93,873.09	
Amount deposited to the credit of the United States Treasurer	38.63	
		93,911.72
July 1, 1895, balance available		16,134.91
Amount that can be profitably expended during fiscal year ending June 30, 1897		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

LEVEES.

For works connected with levee construction and maintenance the district is subdivided into seven levee districts, as follows:

The Lower Tensas levee district, right bank, which extends from the upper limit of the fourth district, opposite Warrenton, to the mouth of Red River, and comprises 157½ miles of the Mississippi River. In this district the levee system is continuous from the upper end down to a point 5 miles below Fairview Landing, a length of 130.5 miles of the river, leaving about 26 miles of the river on this bank unprotected.

Atchafalaya levee district:	
Original allotment	$152,000.00
Transferred to Pontchartrain district	4,633.04
Balance	147,366.96
Lafourche levee district:	
Allotment	90,000.00
Pontchartrain levee district:	
Original allotment	150,000.00
Transferred from Atchafalaya district	4,633.04
Total	154,633.04
Barataria levee district:	
Allotment	60,000.00
Lake Borgne levee district:	
Allotment	50,000.00

The details of the work accomplished under the above allotments are given in the following tables:

Fourth district levees, 1894–95.

LOWER TENSAS LEVEE DISTRICT.

Name of levee.	Below Cairo.	Bank.	Contractor.	Length of line.
	Miles.			*Feet.*
Hard Times-Wilson	631	R.	James R. Marlowe	3,900
Hard Times	632	R.	Garbish & O'Neil	3,983
Kempe, upper section	657	R.	W. J. Bentley & Co	4,600
Kempe, lower section	659	R.	A. P. Martin	15,090
Deer Park	721	R.	Albert H. Gillespie	4,231
Forest Home	722	R.	John Scott & Sons	6,420
Fish Pond Gap	723	R.	James R. Marlowe	65
Ashley	723	R.	Albert H. Gillespie	9,216

Name of levee.	Length of axis of river covered.	Grade of levee above high water, 1890.	Section.		
			Crown.	River slope.	Land slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Hard Times-Wilson	1,900			7 to 1	
Hard Times	3,983	3.3	8	3 1	2½ and 4 and 6 to 1.
Kempe, upper section	4,100	3	8	3 1	Do.
Kempe, lower section	12,000	3.3	8	3 1	Do.
Deer Park	4,000	3	8	3 1	2½ to 1.
Forest Home	5,000	3	8	3 1	2½ and 4 to 1.
Fish Pond Gap	65	2.2	8	3 1	2½ to 1.
Ashley	9,200	3	8	3 1	Do.

Name of levee.	Net fill.			Embankment.		Filled excavations.	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.
	Feet.	*Feet.*	*Feet.*		*Cents.*		*Cents.*
Hard Times-Wilson	1.7	6.8	4	25,119.91	17.7	2,699.07	17.7
Hard Times	5.8	20	14	25,278.84	19.9	170.90	19.9
Kempe, upper section	14.4	24.4	17	58,413.30	32.2	1,805.49	32.2
Kempe, lower section	5.6	19.5	13	49,383.47	23	1,532.78	23
Deer Park	6.8	10.1	8.6	17,958.25	12.4		
Forest Home	8	14.6	10.4	93,749.12	11.7	518.42	11.7
Fish Pond Gap	0.0	14	7	623	17		
Ashley	4.5	12.6	6.4	37,701.46	7.93	70.94	7.93

Name of levee and levee district.	Below Cairo.	Year.
Lafourche levee district, right bank—Continued.	*Miles.*	
White Rose	918	1894
Providence	932	1894
Waterford	932	1894
Flagtown	936.5	1894
Speranza	937	1894
Ashton	940	1894
Lone Star	941.5	1893
Davis	943	1893
Coopersville	944	1894
Pontchartrain levee district, left bank:		
Shannon	837	1891
Shannon, Lower	837	1894
Martinez	842	1891
Conrad	843	1894
Lopez	844.5	1893
Gay to Hollywood	845	1891
Ben Hur	845	1894
Burtville	847	1893
Woodstock	847.5	1891
Hermitage	850	1891
Towles	851	1893
Billings	852.3	1893
Plaquemine Point	853	1894
Grenada to Mount Olive	855.5	1891
Jolisant	858.8	1893
Oakly to St. Gabriel	862	1893
Maryland	872	1894
Hard Times	873	1894
Rescue No. 1	874	1894
Southwood, Upper	874.7	1894
Rescue No. 2	875	1894
Southwood Extension	875.5	1892
Do	875.5	1891
Ashland to Linwood	878	1891
Belle Helene	879	1894
Dicharry	882	1891
Dicharry, Lower	883	1893
Burnside	891	1893
Houmas	891	1894
Irvine	892.5	1891
Union, Upper	893	1893
Union, Lower	893	1893
Union	893.5	1891
Tippecanoe	894	1893
Peytavin	894.5	1893
Whitehall	895	1893
Lilly	900.5	1891
College Point to St. Michael	903.5	1890
College Point	905	1894
Hester	908.5	1894
Tessier-Bourgeois	909.5	1892
Tessier	909.5	1893
St. Elmo	910	1894
Poche	911	1894

Name of levee and levee district.	Below Cairo.	Year.
Pontchartrain levee district, left bank—Continued.	*Miles.*	
Hope	916.5	1893
Terre Haute to Hope	919.5	1891
Terre Haute	921	1894
Reserve	922	1894
Cornland	922	1891
Prospect	936	1894
Destrahan	939	1891
Frellsen to Almedia	942	1891
Trudeau	949	1894
Southport	955.5	1892
Barataria levee district, right bank:		
Magnolia	979	1894
Fort St. Leon, Middle	980.5	1894
Magnolia	980.5	1893
Fort St. Leon, Upper	981.5	1893
Belle Chasse	981.5	1894
Kearney	982.5	1894
Fort St. Leon, Lower	982.5	1893
Belle Chasse Crevasse	983	1893
St. Anne	984	1894
Belle Chasse to Concession	985	1893
Concord	987	1893
Oak Point	988.5	1893
Oakville	990	1894
Live Oak	991.5	1893
Dobard	992.5	1894
Happy Point	994	1893
Star	995.5	1894
Ironton	999.7	1894
Myrtle Grove	1,002.3	1894
Oakland	1,003.2	1894
Deer Range	1,004	1894
Lake Borgne levee district, left bank:		
Slaughter House	968.5	1894
Slaughter House Extension	960.5	1893
Roy	969	1893
Bonzano	969	1893
Chalmette Cemetery	969.5	1893
Battle Ground	969.5	1894
Deboushel	970	1893
Pecan Grove	973	1893
Story, Upper	974	1893
Irving	975	1894
Story, Lower	975	1893
Repose	976	1893
Caernarvon	978.5	1894
Do	979	1893
Orange Grove	979.5	1894
Orange Grove, Upper	980	1893
Orange Grove, Lower	980	1893
English Turn	981	1894
St. Clair	982	1894
Mon Plaisir	983	1894

The foregoing does not include work of minor repairs done to assist in protecting and maintaining the levees during high water.

Under the authority of the act of July 13, 1892, allotments have been made by the Commission as follows for the several levee districts under charge of this office:

Allotments from appropriation for fiscal year 1894–95.

Lower Tensas levee district:		
Original allotment		$132,000.00
Transferred to Middle Tensas district, third district Mississippi River, in accordance with letter of General Comstock	$25,000.00	
Transferred to Middle Tensas district, third district Mississippi River, by resolution of the Commission, meeting of August 8, 1894	40,000.00	
		65,000.00
Balance		67,000.00

Atchafalaya levee district:	
Original allotment	$152,000.00
Transferred to Pontchartrain district	4,633.04
Balance	147,366.96
Lafourche levee district:	
Allotment	90,000.00
Pontchartrain levee district:	
Original allotment	150,000.00
Transferred from Atchafalaya district	4,633.04
Total	154,633.04
Barataria levee district:	
Allotment	60,000.00
Lake Borgne levee district:	
Allotment	50,000.00

The details of the work accomplished under the above allotments are given in the following tables:

Fourth district levees, 1894–95.

LOWER TENSAS LEVEE DISTRICT.

Name of levee.	Below Cairo.	Bank.	Contractor.	Length of line.
	Miles.			*Feet.*
Hard Times-Wilson	631	R.	James R. Marlowe	3,900
Hard Times	632	R.	Garbish & O'Neil	3,983
Kempe, upper section	657	R.	W. J. Bentley & Co	4,600
Kempe, lower section	659	R.	A. P. Martin	15,090
Deer Park	721	R.	Albert H. Gillespie	4,231
Forest Home	722	R.	John Scott & Sons	6,420
Fish Pond Gap	723	R.	James R. Marlowe	65
Ashley	723	R.	Albert H. Gillespie	9,216

Name of levee.	Length of axis of river covered.	Grade of levee above high water, 1890.	Section.		
			Crown.	River slope.	Land slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Hard Times-Wilson	1,900			7 to 1	
Hard Times	3,983	3.3	8	3 1	2½ and 4 and 6 to 1.
Kempe, upper section	4,100	3	8	3 1	Do.
Kempe, lower section	12,000	3.3	8	3 1	Do.
Deer Park	4,000	3	8	3 1	2½ to 1.
Forest Home	5,000	3	8	3 1	2½ and 4 to 1.
Fish Pond Gap	65	2.2	8	3 1	2½ to 1.
Ashley	9,200	3	8	3 1	Do.

Name of levee.	Net fill.			Embankment.		Filled excavations.	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.
	Feet.	*Feet.*	*Feet.*		*Cents.*		*Cents.*
Hard Times-Wilson	1.7	6.8	4	25,119.91	17.7	2,699.07	17.7
Hard Times	5.8	20	14	25,278.84	19.9	170.90	19.9
Kempe, upper section	14.4	24.4	17	58,413.30	32.2	1,805.49	32.2
Kempe, lower section	5.6	19.5	13	49,383.47	23	1,532.78	23
Deer Park	6.8	10.1	8.6	17,958.25	12.4		
Forest Home	8	14.6	10.4	93,749.12	11.7	518.42	11.7
Fish Pond Gap	0.0	14	7	623	17		
Ashley	4.5	12.6	6.4	37,701.46	7.93	70.94	7.93

Fourth district levees, 1894–95—Continued.

LOWER TENSAS LEVEE DISTRICT—Continued.

Name of levee.	Linear feet muck ditch.	Date of contract.	Contract time for completion.	Work commenced.	Work completed.
Hard Times-Wilson	None	Nov. 1, 1894	Feb. 15, 1895	Oct. 23, 1894	Feb. 7, 1895
Hard Times	None	Oct. 5, 1894	Jan. 1, 1895	Oct. 15, 1894	Jan. 1, 1895
Kempe, upper section	None	Nov. 20, 1894	Mar. 1, 1895	Nov. 22, 1894	Mar. 27, 1895
Kempe, lower section	None	do	do	Nov. 28, 1894	Mar. 31, 1895
Deer Park	None	Oct. 5, 1894	Jan. 1, 1895	Oct. 1, 1894	Oct. 31, 1894
Forest Home	None	do	do	Oct. 9, 1894	Mar. 5, 1895
Fish Pond Gap	None	Dec. 18, 1894	Feb. 1, 1895	Jan. 23, 1895	Feb. 25, 1895
Ashley	None	Oct. 5, 1894	Jan. 1, 1895	Oct. 9, 1894	Feb. 8, 1895

Name of levee.	Extension granted to—	Distance from center of levee to river bank.			Nature of river bank.	Remarks.
		Least.	Greatest.	Average.		
	1895.	*Feet.*	*Feet.*	*Feet.*		
Hard Times-Wilson		11,000	12,000	11,500	Caving rapidly	Enlargement of base.
Hard Times		2,700	3,100	2,900	Caving slowly	Enlargement.
Kempe, upper section	Apr. 1	850	1,300	1,075	do	Do.
Kempe, lower section	do	1,900	4,400	3,150	Caving rapidly	Do.
Deer Park		500	760	630	Caving slowly	Do.
Forest Home	Mar. 1	500	2,400	1,450	Caving rapidly	New levee.
Fish Pond Gap		3,000	3,000	3,000	do	Do.
Ashley	Feb. 20	410	1,375	900	Caving slowly	New and enlargement.

ATCHAFALAYA LEVEE DISTRICT.

Name of levee.	Below Cairo.	Bank.	Contractor.	Length of line.
	Miles.			*Feet.*
Smithland	787	R.	Edwin B. Helgason	1,257
Lakeland	799.5	R.	do	1,100
Nina	806	R.	Eltringham Construction Co	5,680
Hermitage Dike	808	R.	James J. Gray	3,385
Anchorage (No. 2)	831	R.	J. M. Sullivan	1,168
Anchorage (No. 1)	831	R.	Hayes Bros	2,974
Cinclare, Upper	838	R.	Marlow & Cary	3,253
Cinclare, Lower	838	R.	Edwin B. Helgason	2,800
Cohn	838	R.	McLaughlin Bros	1,304
Brusley, Upper	839	R.	Geo. Y. Andrews	2,757
Brusley, Lower	839	R.	McLaughlin Bros	2,100
Uhry	841	R.	Mike Tansey	485
St. Delphine	841	R.	J. M. Sullivan	2,497
Eliza	842	R.	do	1,769
Robertson	853.5	R.	Mike Tansey	1,558
St. Louis	856	R.	M. Hannick & Co	5,773
Evergreen	856	R.	Hayes Bros	1,059
Olivia	858	R.	P. J. Millet	6,800
Arcadia	859	R.	Hayes Bros	3,974
Soulouque	860	R.	Donovan & Daley	2,803
Last Hope	860	R.	Sullivan & Gray	1,192
Golden Ridge	861	R.	Alvah Epley	2,380
Point Pleasant	862	R.	Geo. Byrne & Co	2,368
St. Raphael	862	R.	do	5,300
Beatty	863	R.	Sullivan & Gray	1,106
Palo Alto	864	R.	Donovan & Daley	4,042
Dunboyne	865	R.	C. D. Leeper & Co	435
Eimer	866	R.	Donovan & Daley	2,110
Eimer, Lower	866	R.	Curtis & Andrews	1,455
Rice Enlargement	866	R.	Hayes Bros	1,050
Nodaway	868	R.	J. M. Sullivan	7,021
Dorceyville	868	R.	Hayes Bros	1,630
Whitecastle	868	R.	Manning & Gibson	950
Cora	870	R.	Hayes Bros	3,780
Belle Grove	871	R.	Donovan & Daley	2,993
Old Hickory (No. 2)	873	R.	Sullivan & Gray	931
Old Hickory (No. 1)	873	R.	Donovan, Daley & Co	2,900
Claiborne	875	R.	Manning & Gibson	24,968
Elise	877	R.	J. M. Sullivan	2,551
Modeste	878	R.	do	1,617
Babin	879	R.	do	1,899
Landry	879	R.	do	1,792
Smoke Bend	884	R.	do	2,106

Fourth district levees, 1894–95—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

Name of levee.	Length of axis of river covered.	Grade of levee above high water, 1893.	Section.		
			Crown.	River slope.	Land slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
land	1,200	2.5	8	3 to 1	2½ and 4 to 1.
and	1,260	2.5	8	3 1	Do.
	5,470	3.3	8	3 1	2½ to 1.
ttage Dike	2,980	3.7	8	2½ & 3 1	2½ and 4 to 1.
orage (No. 2)	1,170	3	8	3 1	Do.
orage (No. 1)	2,970	3	8	3 1	Do.
ure, Upper	3,230	2.5	8	3 1	Do.
ure, Lower	2,700	2.5	8	3 1	Do.
	1,300	2.5	8	3 1	Do.
ey, Upper	2,680	2.5	8	3 1	Do.
ey, Lower	3,050	2.5	8	3 1	Do.
	480	2.5	8	3 1	Do.
lphine	1,830	3.2	8	3 1	2½ to 1.
	1,750	2.5	8	3 1	2½ and 4 to 1.
tson	880	2.5	8	3 1	Do.
uis	4,600	2.5	8	3 1	Do.
reen	1,030	2.5	8	3 1	Do.
	6,580	2.5	8	3 1	2½ to 1.
lia	4,230	2.5	8	3 1	2½ and 4 to 1.
uque	3,100	2.5	8	3 1	2½ to 1.
Hope	1,270	2.5	8	3 1	Do.
n Ridge	2,820	2.5	8	3 1	Do.
Pleasant	3,600	2.5	8	3 1	Do.
phael	7,850	2.5	8	3 1	Do.
y	1,100	2.5	8	3 1	Do.
Alto	4,020	2.5	8	3 1	Do.
oyne	435	2.5	8	3 1	Do.
	1,930	2.5	8	3 1	2½ and 4 to 1.
, Lower	1,420	2.5	8	3 1	2½ to 1.
Enlargement	1,000	2.5	8	3 1	2½ and 4 to 1.
way	5,460	2.5	8	3 1	Do.
yville	1,400	2.5	8	3 1	Do.
castle	750	2.5	8	3 1	Do.
	3,700	2.5	8	3 1	Do.
Grove	3,000	2.5	8	3 1	Do.
ickory (No. 2)	1,100	2.5	8	3 1	2½ to 1.
ickory (No. 1)	3,440	2.5	8	3 1	Do.
rne	28,100	2.5	8	3 1	Do.
	2,500	2.5	8	3 1	Do.
ite	1,630	2.5	8	3 1	Do.
	1,710	2.5	8	3 1	Do.
y	1,780	2.5	8	3 1	Do.
Bend	1,950	2.5	8	3 1	2½ and 4 to 1.

Name of levee.	Net fill.			Embankment.		Filled excavations.	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.
	Feet.	*Feet.*	*Feet.*		*Cents.*		*Cents.*
land	.1	14.9	10.8	19,061.64	12.95	633.81	12
and	4.5	11.7	10.7	16,574.71	9.90	60.78	9.90
	.2	4.8	1.1	20,305.45	13.18	.....	13.18
ttage Dike	.1	3.7	.8	9,184.63	22.42	4.74	10
orage (No. 2)	2.9	6.7	6.5	9,071.69	12.20	65.34	12.20
orage (No. 1)	1.4	11.8	11	48,590.57	10	909.13	10
re, Upper	.9	11.7	4.4	21,330.71	9	919.92	9
re, Lower	1.1	12.8	1.8	20,632.79	9.95	1,157.27	9.95
	1.6	14.6	12.5	27,518.77	9½	354.67	9½
y, Upper	1	6.8	2.2	20,523.34	13.69	151.22	13.69
y, Lower	1.4	6.1	3.7	24,695.11	9.90	19.19	9.90
	1.4	11.8	11.5	8,137.28	10.92	.....	10
phine	2.5	4.1	3	22,460.70	14.90	.....	10
	.3	2.9	2	14,606.65	16	4.44	8
son	.7	10.8	4.3	14,114.83	9.89	219.24	9
uis	.1	13.3	11.8	111,088.07	11	1,469.34	11
reen	2.4	5.8	3.7	8,503.08	11	18.96	11
	.6	6.4	2.8	28,527.93	11	79.19	11
lia	1.1	4.3	2.4	21,073.15	10.50	.....	10.50
que	.5	4.8	3.2	10,868.21	10.70	65.38	10.70
ope	1	10	9.4	13,438.05	9.43	69.80	9.43
Ridge	.1	10.7	6.2	19,770.57	8.38	7.10	8.38

Fourth district levees, 1894-95—Continued.

LAFOURCHE LEVEE DISTRICT—Continued.

Name of levee.	Length of axis of river covered.	Grade of levee above high water, 1893.	Section.		
			Crown.	River slope.	Land slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Saulsburg	3,900	2.5	8	3 to 1	2½ to 1.
Lauderdale	3,000	2.5	8	3 1	Do.
Ferchaud	1,300	2.5	8	3 1	Do.
Pikes Peak	1,100	2.5	8	3 1	2½ and 4 to 1.
Laura	1,780	2.5	8	3 1	2½ to 1.
Willow Grove	2,350	2.5	8	3 1	Do.
Stevenson	1,200	2.5	8	3 1	2½ and 4 to 1.
Songy	3,850	2.5	8	3 1	Do
Star	1,280	2.5	8	3 1	Do.
Madere	800	2.5	8	3 1	2½ to 1.
Alice, Upper	1,800	2.5	8	3 1	Do.
Fortier	950	2.5	8	3 1	Do.
Soniat	5,220	2.5	8	3 1	Do.
Odier	3,320	2.5	8	3 1	Do.
Willswood	7,000	2.5	8	3 1	Do.
Starlight	2,400	2.5	8	3 1	2½ and 4 to 1.

Name of levee.	Net fill.			Embankment.		Filled excavations.	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.
	Feet.	*Feet.*	*Feet.*		*Cents.*		*Cents.*
Saulsburg	2	10.2	9.1	44,311.49	9	393.71	9
Lauderdale	.2	3.4	1.5	10,632.77	12.15	.....	12.15
Ferchaud	1.2	10.2	9.5	15,986.71	10.68	267.19	10.68
Pikes Peak	.3	4.3	2	9,277.12	13.92	.....	13.92
Laura	.6	3.6	1.5	7,657.25	14	50.22	14
Willow Grove	.3	11	9.3	20,165.24	10.72	98.14	8
Stevenson	1.4	12.7	11	24,532.92	13.40	281.10	10
Songy	.3	11.8	10.4	58,887.92	12	956.92	8
Star	1	11.3	10.5	19,662.47	13	207.30	13
Madere	5.7	8.4	7.4	9,786.26	13	211.43	13
Alice, Upper	1.1	2.5	1.5	3,917.46	14	86.40	10
Fortier	1.3	8.8	8.3	10,025.52	13	211.77	13
Soniat	.1	3.4	1.7	18,742.62	13	414.10	8
Odier	.7	2.5	1.5	8,425.37	13	74.07	13
Willswood	.8	10.1	1.7	38,408.60	12.50	3,895.89	12 50
Starlight	.3	16.4	13.1	68,748.35	12	901.64	12

Name of levee.	Muck ditch.	Date of contract.	Contract time for completion.	Work commenced.	Work completed.
	Lin. ft.				
Saulsburg	.....	Oct. 8, 1894	Feb. 1, 1895	Oct. 2, 1894	Jan. 18, 1895
Lauderdale	.....	Oct. 27, 1894	Jan. 1, 1895	Oct. 19, 1894	Nov. 17, 1894
Ferchaud	.....	Oct. 8, 1894	Dec. 1, 1894	Nov. 12, 1894	Dec. 12, 1894
Pikes Peak	.....	Oct. 27, 1894	Jan. 1, 1895	Nov. 26, 1894	Dec. 13, 1894
Laura	.....	.....do.....	Dec. 15, 1894	Dec. 10, 1894	Jan. 24, 1895
Willow Grove	.....	Dec. 14, 1894	Mar. 1, 1895	Dec. 15, 1894	Jan. 15, 1895
Stevenson	.....	Oct. 27, 1894	Jan. 15, 1895	Dec. 12, 1894	Feb. 25, 1895
Songy	.....	.....do.....	Mar. 1, 1895	Oct. 18, 1894	Jan. 3, 1895
Star	.....	.....do.....	Jan. 1, 1895	Nov. 5, 1894	Dec. 24, 1894
Madere	.....	.....do.....	.....do.....	Nov. 7, 1894	Jan. 28, 1895
Alice, Upper	.....	.....do.....	Jan. 15, 1895	Nov. 9, 1894	Dec. 28, 1894
Fortier	.....	.....do.....	Jan. 1, 1895	Dec. 7, 1894	Jan. 6, 1895
Soniat	.....	.....do.....	Jan. 15, 1895	Dec. 25, 1894	Jan. 29, 1895
Odier	.....	.....do.....	Jan. 1, 1895	Oct. 31, 1894	Dec. 8, 1894
Willswood	3,550	.....do.....	Feb. 15, 1895	Dec. 14, 1894	Feb. 25, 1895
Starlight	.....	Dec. 14, 1894	Mar. 1, 1895	Dec. 7, 1894	Mar. 8, 1895

Fourth district levees, 1894–95—Continued.

LAFOURCHE LEVEE DISTRICT—Continued.

Name of levee.	Extension granted to—	Distance from center of levee to river bank.			Nature of river bank.	Remarks.
		Least.	Greatest.	Average.		
	1894.	*Feet.*	*Feet.*	*Feet.*		
Saulsburg		100	310	200	Caving periodically, washing.	New.
Lauderdale		70	340	140	....do	Enlargement.
Ferchand	Dec. 12	130	240	160	....do	New.
Pikes Peak		430	590	510	Caving	Enlargement.
	1895.					
Laura	Feb. 10	90	270	180	Washing	Do.
Willow Grove		120	280	170	Practically permanent	New and enlargement.
Stevenson	Mar. 1	80	400	250	Washing, caving	New.
Songy		70	190	150	Washing	Do.
Star		260	320	300	Caving periodically	Do.
Madere	Jan. 18	60	340	190	Washing	Do.
Alice, Upper		160	260	210	Caving periodically, washing.	Enlargement.
Fortier	Jan. 5	90	190	170	Washing	New.
Soniat	Feb. 10	90	160	130	Practically permanent	Enlargement.
Odler		140	360	280	....do	Do.
Willswood	Mar. 10	105	440	290	Part permanent, part washing.	New and enlargement.
Starlight	Mar. 8	255	440	340	Caving	New.

PONTCHARTRAIN LEVEE DISTRICT.

Name of levee.	Below Cairo.	Bank.	Contractor.	Length of line.
				Feet.
Gourier	837	L.	Eltringham Construction Co	2,900
Revenue	874	L.	Donovan, Daley & Co	2,424
Darrowville	886	L.	George Kilkenny	2,735
St. Marys Chapel	894.5	L.	Donovan & Daley	2,961
Jacob	901	L.	J. A. Carson	2,339
Convent	903	L.	C. D. Leeper & Co	5,665
Belmont	907	L.	P. J. Millet	3,151
Venus	909	L.	Eltringham Construction Co	948
David	914	L.	....do	2,911
Old Church	914	L.	Hayes Bros	718
Golden Grove	914.5	L.	C. D. Leeper & Co	4,753
Sport	915	L.	Manning & Gibson	1,144
Hope, Lower	917	L.	....do	1,700
Belle Point	924	L.	Edwin B. Helgason	6,060
Roat	940	L.	John Mahoney	4,396
Modoc (No. 2)	940.5	L.	Williford & Ryan	1,643
Modoc (No. 1)	940.5	L.	Manning & Gibson	949
Frellsen (No. 1)	945	L.	Hayes Bros	900
Frellsen (No. 2)	945	L.	R. M. Quigley & Co	1,342
Kenner	947	L.	Williford & Ryan	2,222

Name of levee.	Length of axis of river covered.	Grade of levee above high water, 1893.	Section.		
			Crown.	River slope.	Land slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Gourier	2,680	2.5	8	3 to 1	2½ and 4 to 1.
Revenue	2,115	2.5	8	3 1	Do.
Darrowville	2,700	2.5	8	3 1	2½ to 1.
St. Marys Chapel	2,950	2.5	8	3 1	Do.
Jacob	2,260	2.5	8	3 1	Do.
Convent	5,330	2.5	8	3 1	Do.
Belmont	3,060	2.5	8	3 1	2½ and 4 to 1.
Venus	900	2.5	8	3 1	Do.
David	2,900	2.5	8	3 1	2½ to 1.
Old Church	700	2.5	8	3 1	Do.
Golden Grove	4,650	2.5	8	3 1	Do.
Sport	870	2.5	8	3 1	2½ and 4 to 1.
Hope, Lower	1,670	2.5	8	3 1	2½ to 1.
Belle Point	5,500	2.5	8	3 1	Do.
Roat	4,300	2.5	8	3 1	Do.
Modoc (No. 2)	1,640	2.5	8	3 1	Do.
Modoc (No. 1)	950	2.5	8	3 1	Do.
Frellsen (No. 1)	870	2.5	8	3 1	2½ and 4 to 1.
Frellsen (No. 2)	1,100	2.5	8	3 1	Do.
Kenner	2,150	2.5	8	3 1	Do.

Fourth district levees, 1894–95—Continued.

PONTCHARTRAIN LEVEE DISTRICT—Continued.

Name of levee.	Net fill.			Embankment.		Filled excavations.	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.
	Feet.	*Feet.*	*Feet.*		*Cents.*		*Cents.*
Gourier	1.6	14.6	14	74,105.57	15.40	155.09	14
Revenue	.7	12.9	12	46,651.98	11.39	351.36	11.39
Darrowville	.3	11.2	9.8	35,024.03	10.40	261.08	10
St. Marys Chapel	.5	9.6	8	28,389.18	8.94	435.16	8
Jacob	8.2	9.6	9.2	25,447.82	10.99	727.74	10.99
Convent	1.8	11.6	4.3	44,971.01	8.97	563.14	8.97
Belmont	4.5	13.5	12.4	64,744.45	14	803.14	14
Venus	.1	13.7	11.2	17,970.58	11	144.92	7
David	2.1	10.3	9.8	32,495.90	12	507	12
Old Church	2.1	10.5	9.6	8,418.34	14	85.21	8
Golden Grove	1.7	7.3	2.6	30,467.31	10.45	7,187.27	10.45
Sport	1.7	10.8	10.4	16,867.74	10.74	212.82	10.74
Hope, Lower	.4	9.9	9	18,238.91	11	226.10	11
Belle Point	.5	10.1	4.7	43,106.28	8.95	399.36	8.95
Rost	.5	9.1	8.5	43,039.33	10.89	729.49	10.89
Modoc (No. 2)	2.1	2.9	2.7	8,152.37	10.44	2,245.73	10.44
Modoc (No. 1)	2.1	10.5	9.3	11,658.75	11	287.22	11
Frellsen (No. 1)	12.7	13.4	12.9	20 308.93	10.25	117.38	10.25
Frellsen (No. 2)	.2	14.5	13.2	31,025.95	13	192.44	13
Kenner	1	11.9	11.1	35,692.43	12.69	796.97	12 69

Name of levee.	Muck ditch.	Date of contract.	Contract time for completion.	Work commenced.	Work completed.
	Lin. ft.				
Gourier		Oct. 27, 1894	Mar. 1, 1895	Nov. 21, 1894	Mar. 26, 1895
Revenue		Jan. 20, 1894	June 30, 1895	Feb. 6, 1894	Sept. 13, 1894
Darrowville		Oct. 27, 1894	Feb. 15, 1895	Nov. 5, 1894	Jan. 19, 1895
St. Marys Chapel		Jan. 21, 1895	Mar. 1, 1895	Jan. 22, 1895	Mar. 3, 1895
Jacob		Oct 8, 1894	Dec. 15, 1894	Oct. 2, 1894	Nov. 13, 1894
Convent		Mar 14, 1894	June 30, 1895	Mar. 15, 1894	July 25, 1894
Belmont		Oct. 8, 1894	Feb. 15, 1895	Oct. 3, 1894	Jan. 19, 1895
Venus		Mar. 10, 1894	June 30, 1895	June 26, 1894	Aug. 25, 1894
David		Oct. 27, 1894	Feb. 15, 1895	Nov. 26, 1894	Feb. 19, 1895
Old Church		....do	Dec. 15, 1894	Oct. 22, 1894	Nov. 26, 1894
Golden Grove	4,150	Feb. 19, 1895	Apr. 1, 1895	Feb. 22, 1895	Apr. 13, 1895
Sport		Mar. 14, 1894	June 30, 1895	Dec. 17, 1894	Mar. 16, 1895
Hope, Lower		Dec. 1, 1893	.....do	July 30, 1894	Sept. 13, 1894
Belle Point		Mar. 10, 1894	.....do	Feb. 22, 1894	Sept. 22, 1894
Rost		Dec. 1, 1893	.....do	July 18, 1894	Sept. 24, 1894
Modoc (No. 2)	1,535	Jan. 21, 1895	Mar. 1, 1895	Jan. 31, 1895	Mar. 4, 1895
Modoc (No. 1)		Dec. 1, 1894	June 30, 1895	June 19, 1894	July 25, 1894
Frellsen (No. 1)		Dec. 1, 1893	.....do	July 6, 1894	Aug. 28, 1894
Frellsen (No. 2)		Oct. 8, 1894	Dec. 15, 1894	Oct. 22, 1894	Nov. 30, 1894
Kenner		Oct. 27, 1894	Feb. 15, 1895	Dec. 22, 1894	Feb. 10, 1895

Name of levee.	Extension granted to—	Distance from center of levee to river bank.			Nature of river bank.	Remarks.
		Least.	Greatest.	Average.		
	1895.	*Feet.*	*Feet.*	*Feet.*		
Gourier	Apr. 1	370	845	590	Caving	New.
Revenue		260	590	380	.....do	Do.
Darrowville		155	360	230	Caving periodically; washing.	Do.
St. Marys Chapel		95	170	140	Practically permanent.	New and enlargement.
Jacob		130	345	250	Caving periodically; washing.	New.
Convent		100	210	160	Practically permanent.	New and enlargement.
Belmont		415	590	520	Caving	New.
Venus		290	500	400	.....do	Do.
David	Feb. 19	120	275	150	Practically permanent.	New and enlargement.
Old Church		160	190	170	.....do	New.
Golden Grove	Apr. 20	120	265	200	Sloughing; washing	Enlargement.
Sport		150	440	230	Sloughing	New.
Hope Lower		180	240	210	Practically permanent.	Do.
Belle Point		60	240	130	.....do	New and enlargement.
Rost		40	170	110	.....do	New.
Modoc (No. 2)	Mar. 10	150	220	175	.....do	Enlargement.
Modoc (No. 1)		180	220	200	.....do	New.
Frellsen (No. 1)		310	420	380	Caving	Do.
Frellsen (No. 2)		210	420	360	.... do	Do.
Kenner		190	320	200	Caving periodically	New and enlargement.

Fourth district levees, 1894–95—Continued.

BARATARIA AND LAKE BORGNE LEVEE DISTRICTS.

Name of levee.	Below Cairo.	Bank.	Contractor.	Length of line.
Barataria district:	*Miles.*			*Feet.*
Getzinger	960	R.	Israel R. Bobbitt	1,116
Bell	960.6	R.	do	2,962
Browns	961.7	R.	do	895
Kearney, Upper	962.2	R.	do	1,240
Kearney, Lower	963.1	R.	John A. Carson	1,081
Concession	985.3	R.	Barbour & Ruple	2,069
Concord, Upper	986	R.	John A. Carson	1,300
Concord, Lower	987	R.	do	1,988
Cedar Grove	989	R.	Israel R. Bobbitt	5,135
Sarah	991	R.	Donovan & Daley	3,578
Live Oak Extension	992	R.	Donovan, Daley & Co	1,021
La Reussite	996.4	R.	Barbour & Ruple	1,307
La Rose	1,003.4	R.	do	1,888
Hermitage	1,005.7	R.	do	514
Woodland	1,009.7	R.	do	1,463
Riceland	1,015.6	R.	Martin Head	1,526
Lake Borgne district:				
Sugar House	970.6	L.	Israel R. Bobbitt	1,280
Violet	975.5	L.	John Cleary	720
Merritt	976	L.	John Mahoney	4,214
Caernarvon, Upper	978	L.	Robert McNamara	1,445
Stella, Upper	985.9	L.	Israel R. Bobbitt	920
Stella	986	L.	Jeffries & Dameron	3,458
Linwood	988.7	L.	John Cleary	724
Greenwood	990	L.	Donovan, Daley & Co	4,968
Fanny	993.5	L.	Martin Head	2,992
Fairview, Upper	996.4	L.	Israel R. Bobbitt	2,335
Fairview	997	L.	Robert McNamara	1,786
Fairview, Lower	997.4	L.	do	2,182
Burbridge	998.5	L.	Barbour & Ruple	1,324
Monsecour	999.4	L.	Robert McNamara	2,860
Davis	1,009.4	L.	John Cleary	1,000
Fort St. Philip	1,039.2	L.	Robert McNamara	3,700

Name of levee.	Length of axis of river covered.	Grade of levee above high water 1893.	Section.		
			Crown.	River slope.	Land slope.
Barataria district:	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Getzinger	1,050	2.5	8	3 to 1	2½ and 4 to 1.
Bell	2,900	2.5	8	2 & 4 1	2½ to 1.
Browns	830	2.5	8	2 & 4 1	Do.
Kearney, Upper	1,200	2.5	8	3 1	Do.
Kearney, Lower	1,100	2.5	8	2 & 4 1	Do.
Concession	2,050	2.5	8	2 & 4 1	Do.
Concord, Upper	1,300	2.5	8	3 1	Do.
Concord, Lower	1,925	2.5	8	3 1	Do.
Cedar Grove	5,100	2.5	8	3 1	Do.
Sarah	3,450	2.5	8	2 & 4 1	Do.
Live Oak Extension	1,010	2.5	8	2 & 4 1	Do.
La Reussite	1,200	2.5	8	2 & 4 1	Do.
La Rose	1,800	2.5	8	2 & 4 1	Do.
Hermitage	430	2.5	8	2 & 4 1	Do.
Woodland	1,400	2.5	8	2 & 4 1	Do.
Riceland	1,400	2.5	8	3 1	Do.
Lake Borgne district:					
Sugar House	1,350	2.5	8	2 & 4 1	Do.
Violet	650	2.5	8	2 & 4 1	Do.
Merritt	4,100	2.5	8	3 1	Do.
Caernarvon, Upper	1,350	2.5	8	3 1	2½ and 4 to 1.
Stella, Upper	920	2.5	8	3 1	2½ to 1.
Stella	3,500	2.5	8	3 1	Do.
Linwood	700	2.5	8	2 & 4 1	Do.
Greenwood	4,900	2.5	8	3 1	Do.
Fanny	3,000	2.5	8	3 1	Do.
Fairview, Upper	4,250	2.5	8	3 1	Do.
Fairview	1,750	2.5	8	3 1	Do.
Fairview, Lower	2,180	2.5	8	3 1	Do.
Burbridge	1,320	2.5	8	3 1	Do.
Monsecour	2,850	2.5	8	2 & 4 1	Do.
Davis	1,000	2.5	8	2 & 4 1	Do.
Fort St. Philip	3,200	2.5	6	3 1	2 to 1.

Fourth district levees, 1894–95—Continued.

BARATARIA AND LAKE BORGNE LEVEE DISTRICTS—Continued.

Name of levee.	Net fill.			Embankment.		Filled excavati	
	Least.	Greatest.	Average.	Cubic yards.	Price per cubic yard.	Cubic yards.	P per y
Barataria district:	*Feet.*	*Feet.*	*Feet.*		*Cents.*		C
Getzinger	10	12.4	11.4	18,830.82	13⅞	105.54	
Bell	8.4	11.5	9.6	35,579.86	13¾	1,012.81	
Browns	6.9	9	7.8	7,275.08	14½	141.59	
Kearney, Upper	8.1	9	9	12,134.86	13½	361.36	
Kearney, Lower	6	8	7.7	7,958.91	14	643.51	
Concession	5.9	11.6	8	16,752.44	14.20	1,917.30	
Concord, Upper	7.2	8.2	7.8	11,449.84	12	608.92	
Concord, Lower	8.3	9.9	9.1	21,845.47	12	881.26	
Cedar Grove	5.5	7	6.1	27,986.97	14.75	746.99	
Sarah	6.3	8	7.2	24,190.24	13.39	1,237.25	
Live Oak Extension	4.6	8.3	7.3	6,736.43	13.94	678.20	
La Reussite	2.1	6.5	5.3	4,914.15	16	69.69	
La Rose	.4	7.4	6.6	7,660.06	14.75	221.51	
Hermitage	5.8	7.4	6.1	2,482.85	15	155.71	
Woodland	5.6	7.8	6.9	8,466.33	14.75	846.64	
Riceland	5.5	8	6.7	10,029.82	16½	474.16	
Lake Borgne district:							
Sugar House	4.9	7.3	6.3	6,962.24	14½	462.04	
Violet	4.1	7.8	6.8	4,380.72	13	227.02	
Merritt	7.3	9.4	8.5	40,640.86	13.85	1,047.35	
Caernarvon, Upper	11	12.5	11.3	22,825.55	14	369.95	
Stella, Upper	.7	3.9	2	1,894.75	16½	10.54	
Stella	4.5	5.1	5.1	12,024.70	13	239.70	
Linwood	7	7.7	7	1,677.72	14	80.50	
Greenwood	6.2	9.2	8.3	42,971.15	12.90	1,767.32	
Fanny	5.3	7	6.3	17,290.39	12½	1,158.85	
Fairview, Upper	6.5	8.2	7.4	18,538.39	13.90	399.35	
Fairview	5.1	8.1	7.4	13,171.34	14	259.68	
Fairview, Lower	1.2	3.8	5.1	5,877.15	14	274.51	
Burbridge	1	1.9	1.6	3,905.05	15	335.02	
Monsecour	8.1	9.4	8.6	27,101.34	13½	1,056.47	
Davis	5.7	7.1	6.6	5,533.85	13½	105.66	
Fort St. Philip	0.9	4 4	1.8	5,168.77	18	595.31	

Name of levee.	Muck ditch.	Date of contract.	Contract time for completion.	Work commenced.	Work plete
Barataria district:	*Lin. ft.*				
Getzinger		Oct. 8, 1894	Jan. 1, 1895	Oct. 1, 1894	Nov. 2
Bell	225	Nov. 1, 1894	Feb. 1, 1895	Oct. 23, 1894	Dec. 2
Browns		do	Jan. 15, 1895	Nov. 20, 1894	Jan.
Kearney, Upper		Jan. 14, 1895	Mar. 1, 1895	Jan. 22, 1895	Feb. 2
Kearney, Lower		Nov. 20, 1894	Jan. 15, 1895	Nov. 17, 1894	Dec. 1
Concession	1,525	do	Feb. 1, 1895	Dec. 26, 1894	Mar.
Concord, Upper		Oct. 8, 1894	Jan. 1, 1895	Dec. 3, 1894	Jan. 3
Concord, Lower	45	do	do	Nov. 17, 1894	Do.
Cedar Grove	14	Nov. 1, 1894	Feb. 1, 1895	Nov. 29, 1894	Jan. 1
Sarah		do	do	Oct. 25, 1894	Dec. 1
Live Oak Extension	963	Mar. 10, 1894	June 30, 1895	July 12, 1894	Sept. 1
La Reussite		Nov. 20, 1894	Feb. 1, 1895	Dec. 19, 1894	Jan. 3
La Rose		do	do	Dec. 31, 1894	Feb.
Hermitage		do	Jan. 15, 1895	Dec. 17, 1894	Jan.
Woodland		do	Feb. 1, 1895	Jan. 21, 1895	Mar.
Riceland		Nov. 1, 1894	Feb. 15, 1895	Dec. 12, 1894	Jan. 1
Lake Borgne district:					
Sugar House	100	Dec. 1, 1893	June 30, 1895	Aug. 23, 1894	Sept.
Violet		Jan. 14, 1895	Mar. 1, 1895	Jan. 18, 1895	Dec. 1
Merritt		Dec. 1, 1893	June 30, 1895	Oct. 8, 1894	Do.
Caernarvon, Upper		Oct. 8, 1894	Jan. 1, 1895	Oct. 9, 1894	Jan.
Stella, Upper		Nov. 1, 1894	Jan. 15, 1895	Oct. 16, 1894	Oct. 2
Stella		Dec. 1, 1893	June 30, 1895	July 25, 1894	Sept. 1
Linwood		Jan. 14, 1895	Mar. 1, 1895	Jan. 18, 1895	Feb. 2
Greenwood		Jan. 20, 1894	June 30, 1895	July 18, 1894	Oct. 1
Fanny		Nov. 1, 1894	Feb. 1, 1895	Oct. 23, 1894	Dec.
Fairview, Upper		do	do	Jan. 2, 1895	Jan. 2
Fairview		do	do	Nov. 6, 1894	Jan. 2
Fairview, Lower		do	do	Nov. 3, 1894	Jan. 2
Burbridge		Nov. 20, 1894	Jan. 15, 1895	Nov. 29, 1894	Jan. 1
Monsecour		Nov. 1, 1894	Feb. 1, 1895	Oct. 29, 1894	Jan. 2
Davis		Nov. 20, 1894	Jan. 15, 1895	Nov. 30, 1894	Jan. 1
Fort St. Philip		Feb. 4, 1895	Apr. 1, 1895	Feb. 18, 1895	Mar. 2

Fourth district levees, 1894–95—Continued.

BARATARIA AND LAKE BORGNE LEVEE DISTRICTS—Continued.

Name of levee.	Extension granted to—	Distance from center of levee to river bank.			Nature of river bank.	Remarks.
		Least.	Greatest.	Average.		
Barataria district:	1895.	*Feet.*	*Feet.*	*Feet.*		
Getzinger		230	290	250	Washing	New.
Bell		162	345	235	Washing and caving	Do.
Browns		115	180	150	Washing and sloughing.	Do.
Kearney, Upper		275	300	280	....do	Do.
Kearney, Lower		135	215	175	....do	Do.
Concession	Mar. 15	70	125	100	Practically permanent	Do.
Concord, Upper	Feb. 1	190	255	215	Washing and slightly caving.	Do.
Concord, Lower	Jan. 31	175	245	220	....do	Do.
Cedar Grove		140	225	170	Washing	Do.
Sarah		120	170	145	Washing and chipping.	Do.
Live Oak Extension.		95	150	105	....do	Do.
La Reussite		150	170	160	Practically permanent	Do.
La Rose	Feb. 1	60	115	95	Washing	New and enlargement.
Hermitage		100	175	140	Sloughing	New.
Woodland	Feb. 25	120	180	140	Washing	Do.
Ricel and		210	315	265	Caving	Do.
Lake Borgne district:						
Sugar House		105	160	140	Washing	Do.
Violet		150	210	180	Washing and old slough.	Do.
Merritt		165	255	170	Washing	Do.
Carmarvon, Upper		300	405	355	Washing and caving	Do.
Stella, Upper		80	100	90	....do	Enlargement.
Stella		105	370	235	....do	New and enlargement.
Linwood		105	120	105	....do	Enlargement.
Greenwood		100	295	210	....do	New.
Fanny		190	235	210	....do	Do.
Fairview, Upper		225	325	260	....do	Do
Fairview		170	255	230	....do	Do.
Fairview, Lower		240	315	275	....do	Enlargement.
Burbridge		80	145	115	....do	Do.
Monsecour		120	195	140	....do	New.
Davis		120	155	130	Washing and slight caving.	Do.
Fort St. Philip		50	550	200	Practically permanent	Enlargement.

Fourth district levee revetment, 1894–95.

BARATARIA AND LAKE BORGNE LEVEE DISTRICTS.

Name of levee.	Below Cairo.	Section.	Contractor.	Length.	Price per linear foot.
Barataria district:	*Miles.*			*Feet.*	*Cents.*
Bell	960.6	A	R. M. Quigley & Co	2,983.5	49½
Browns	961.7			898.9	49½
Kearney, Lower	983.1	B	....do	1,062.9	50
Concession	985.3		Robert McNamara	2,064.6	60
Sarah	991	B	R. M. Quigley & Co	3,588.4	50
Live Oak Extension	992			1,044.3	50
Star, Upper	994.5	C	Barbour & Ruple	Omitted.	41.45
La Reussite	996.4			931.8	41.45
La Rose	1,003.4	D	....do	1,868.4	45.47
Purcelle	1,003.8			Omitted.	45.47
Hermitage	1,005.7			Omitted.	45.47
Woodland	1,009.7	E	....do	1,482.4	46
West Pointe a la Hache	1,010.6			Omitted.	46
Lake Borgne district:					
Sugar House	970.6	F	....do	1,261.1	46.40
Linwood	988.7		Robert McNamara	730.2	60
Fanny	993.5	G	R. M. Quigley	Omitted.	50
Bezair	995			Omitted.	50
Monsecour	999.4			1,600	50
Davis	1,009.4		Robert McNamara	1,003.3	58

Fourth district levee revetment, 1894–95—Continued.

BARATARIA AND LAKE BORGNE LEVEE DISTRICTS—Continued.

Name of levee.	Date of contract.	Contract time for completion.	Work commenced.	Extension granted to—	Work completed.
Barataria district:					
Bell	Dec. 8, 1894	Mar. 1, 1895	Dec. 30, 1894	.....	Jan. 18, 1895
Browns					
Kearney, Lower	....do	....do	Feb. 21, 1895	.....	Feb. 27, 1895
Concession	Jan. 28, 1895	....do	Feb. 27, 1895	Mar. 20, 1895	Mar. 25, 1895
Sarah	Dec. 8, 1894	....do	Jan. 22, 1895	.....	Feb. 27, 1895
Live Oak Extension					
Star, Upper	....do	....do	Mar. 18, 1895	Mar. 25, 1895	Mar. 23, 1895
La Reussite					
La Rose					
Purcelle	....do	....do	Mar. 4, 1895	....do	Mar. 20, 1895
Hermitage					
Woodland	....do	....do	Mar. 21, 1895	....do	Mar. 27, 1895
West Pointe a la Hache					
Lake Borgne district:					
Sugar House	....do	....do	Mar. 3, 1895	....do	Mar. 26, 1895
Linwood	Jan. 28, 1895	....do	Mar. 13, 1895	Mar. 20, 1895	Mar. 20, 1895
Fanny					
Belair	Dec. 8, 1894	....do	Mar. 4, 1895	Mar. 15, 1895	Mar. 12, 1895
Monsecour					
Davis	Jan. 28, 1895	....do	Mar. 4, 1895	Mar. 20, 1895	Mar. 22, 1895

SUMMARY OF LEVEES BUILT FROM JUNE 1, 1894, TO MAY 1, 1895.

	Levee district.					
	Lower Tensas.	Atchafalaya.	Lafourche.	Pontchartrain.	Barataria.	Lake Borgne.
Total earthwork .....cubic yards..	315,025	1,036,097	377,218	653,205	233,549	237,646
Total embankment.....linear feet..	47,505	132,072	42,168	51,861	29,083	35,908
Total axis of river covered.....do....	40,248	134,455	41,250	49,295	28,145	37,020
Total revetment.....do....	.....	.....	.....	.....	15,925	4,595

GRAND SUMMARY OF LEVEES BUILT FROM JUNE 1, 1894, TO MAY 1, 1895.

Earthwork	cubic yards..	2,852,740
Embankment	linear feet..	358,597
Axis of river covered	do....	330,413
Revetment	do....	20,520

In addition to the foregoing work of construction numerous minor repairs to levees have been made in the way of restoring embankments injured by wave wash and the action of rains, repairing weak places, stopping leaks, clearing of weeds, etc.

Statement of yardage of levee work done by the United States and others in the fourth district, Mississippi River.

	Levee district.					
	Lower Tensas.	Atchafalaya.	Lafourche.	Pontchartrain.	Barataria.	Lake Borgne.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
Aggregate levees on Mississippi River May 1, 1894	10,448,954	10,871,816	5,199,161	8,860,452	1,630,992	1,942,361
Added by the United States up to May 1, 1895	315,025	1,036,097	377,218	653,205	233,549	237,646
Added by others up to May 1, 1895	258,837	431,721	19,644	151,740	29,629	58,542
Total	11,022,816	12,339,634	5,596,023	9,665,397	1,894,170	2,238,549
Lost by caving or abandonment May 1, 1894, to May 1, 1895	116,000	43,920	3,160	28,100	157,300	142,000
Aggregate remaining May 1, 1895	10,906,816	12,295,714	5,592,863	9,637,297	1,736,870	2,096,549

Percentage of length of existing levee system built to date by the United States.

	Per cent.
Lower Tensas levee district	52
Atchafalaya levee district	43
Lafourche levee district	26.8
Pontchartrain levee district	43.3
Barataria levee district	19.4
Lake Borgne levee district	18
Percentage of total length of existing levee system fourth district, Mississippi River, built by the United States	36.6

HIGH WATER.

The following table shows the reading of the high-water mark at each of the regular gauges in this district for the past three years:

Gauges.	Bank full stage.	High water, 1892.		High water, 1893.		High water, 1894.	
		Reading.	Date.	Reading.	Date.	Reading.	Date.
	Feet.	*Feet.*		*Feet.*		*Feet.*	
Vicksburg	44	48.40	June 4	48.30	May 22-23	40.90	Apr. 2.
St. Joseph	39.5	44.55	June 3	43.95	May 20	36.90	Apr. 2, 3.
Natchez	47	48.10	June 26	46.80	May 23	40.60	Apr. 3, 4.
Red River Landing	40	48.87	June 27	47.72	June 25	39.50	Apr. 5, 6.
Barbres	40	49.70	June 28	48.70	June 26	39.15	Apr. 6, 7.
Bayou Sara	36	42.25	do	41.50	June 24	33.10	Apr. 5, 6, 7.
Baton Rouge	29	38.45	do	38.40	June 23	30.95	Apr. 5.
Plaquemine	24.7	33.70	June 13	33.75	do	26.90	Apr. 6.
Donaldsonville	24	30.15	do	30.60	do	24.35	Apr. 5, 6.
College Point	21	25.45	June 12	26	do	20.55	Apr. 5.
Carrollton	9.2	17.25	June 13	17.45	June 22	13.70	Apr. 6.
New Orleans	9	17.60	June 11	17.90	June 24	14.60	Do.
Fort Jackson	.....	6.85	June 13	6.70	June 15	5.80	Apr. 8, 9. Oct. 8.

It will be observed that the high water of 1894 was very moderate and did not put the levee system to a severe test. There were no crevasses during the year.

There has been a remarkable decrease in the cost of levee building during recent years, as set forth in the following table. The progress made is attributed mainly to increased competition and the increasing use of the wheel scraper. It is believed that these low prices have come to stay, and that they may be even further reduced by the introduction of mechanical means and steam power. They constitute a most important element in the consideration of the problem of controlling the Mississippi River, as they render financially possible an increased height of levee that could hardly have been undertaken at the prices current when the improvement of the river was first started.

Year.	Levee constructed by the United States.	Total cost.	Average cost per cubic yard.	Year.	Levee constructed by the United States.	Total cost.	Average cost per cubic yard.
	Cubic yards.		*Cents.*		*Cubic yards.*		*Cents.*
1883	1,564,284	$405,374.91	25.9	1891	1,409,742	$300,144.97	21.2
1884	187,000	49,550.00	26.5	1892	907,638	161,851.50	17.8
1885	264,730	56,274.25	21.3	1893	2,141,685	459,834.86	21.4
1886	58,006	8,845.00	15.2	1894	3,629,201	542,967.39	14.9
1889	460,310	133,150.35	28.9	1895	3,402,049	423,410.81	12.4
1890	895,176	172,974.69	19.3				

LOWER TENSAS LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $75,291.04, distributed as follows:

Office expenses (main office)	$2,622.41
Other administrative expenses	7,120.27
Construction of levees	55,337.76
Repairs to levees	5,318.14
Protection to levees	728.67
Steamers	1,570.64

Surveys	$2,158.82
Repairs to plant	23.25
Care of plant	381.93
New plant	29.15
Total	75,291.04

Money statement.

June 1, 1894, balance unexpended		$21,220.88
Amount allotted from appropriation, act of August 17, 1894	$132,000.00	
Transferred to Middle Tensas levee district	65,000.00	
		67,000.00
Amount overpaid on voucher		.20
Amount allotted from appropriation, act of March 2, 1895	132,000.00	
Transferred to Middle Tensas levee district	$40,000.00	
Transferred to Homochitto levee district	2,640.00	
	42,640.00	
		89,360.00
Total available		177,581.08
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repair of levees	74,562.37	
Protection	728.67	
		75,291.04
July 1, 1895, balance unexpended		102,290.04
July 1, 1895, amount covered by uncompleted contracts		10,375.00
July 1, 1895, balance available		91,915.04

ATCHAFALAYA LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $136,518.05, distributed as follows:

Office expenses (main office)	$3,959.56
Other administrative expenses	8,052.28
Construction of levees	120,264.36
Repairs to levees	587.04
Protection to levees	498.90
Steamers	2,393.42
Surveys	658.67
Repairs to plant	17.88
Care of plant	28.37
New plant	57.57
Total	136,518.05

Money statement.

June 1, 1894, balance unexpended		$14,626.61
Amount allotted from appropriation, act of August 17, 1894	$152,000.00	
Transferred to Pontchartrain levee district	4,633.04	
		147,365.96
Amount allotted from appropriation, act of March 2, 1895	152,000.00	
Transferred to Homochitto levee district	3,040.00	
		148,960.00
Balance available		310,953.57
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repair of levees	136,019.15	
Protection	498.90	
		136,518.05
July 1, 1895, balance unexpended		174,435.52
July 1, 1895, amount covered by uncompleted contracts		13,473.00
July 1, 1895, balance available		160,962.52

LAFOURCHE LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $61,059.53, distributed as follows:

Office expenses (main office)	$6,008.54
Other administrative expenses	4,930.03
Construction of levees	45,329.52
Repairs to levees	440.13
Protection to levees	617.28
Steamers	2,957.31
Surveys	530.39
Repairs to plant	2.00
Care of plant	141.01
New plant	103.32
Total	61,059.53

Money statement.

June 1, 1894, balance unexpended		$11,572.60
Amount allotted from appropriation, act of August 17, 1894		90,000.00
Amount allotted from appropriation, act of March 2, 1895	$90,000.00	
Transferred to Homochitto levee district	1,800.00	
		88,200.00
Balance available		189,772.60
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repairs	60,442.25	
Protection	617.28	
		61,059.53
July 1, 1895, balance unexpended		128,713.07
July 1, 1895, amount covered by uncompleted contracts		9,084.80
July 1, 1895, balance available		119,628.27

BARATARIA LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $48,830.70, distributed as follows:

Office expenses (main office)	$1,792.67
Other administrative expenses	3,605.49
Construction of levees	40,104.19
Repairs to levees	635.89
Protection to levees	173.37
Steamers	1,308.29
Surveys	1,119.32
Repairs to plant	21.53
Care of plant	16.00
New plant	50.95
Miscellaneous	3.00
Total	48,830.70

Money Statement.

June 1, 1894, balance unexpended		$12,354.98
Amount allotted from appropriation, act of August 17, 1894		60,000.00
Amount allotted from appropriation, act of March 2, 1895	$60,000.00	
Transferred to Homochitto levee district	1,200.00	
		58,800.00
Balance available		131,154.98
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repair of levees	48,657.33	
Protection	173.37	
		48,830.70
July 1, 1895, balance unexpended		82,324.28

HOMOCHITTO LEVEE DISTRICT.

Amount transferred from the following:		
Allotments for other districts, being 2 per cent:		
Lower St. Francis	$1,760.00	
Upper Yazoo	2,000.00	
Lower Yazoo	3,000.00	
Upper White River	1,060.00	
Lower White River	1,500.00	
Upper Tensas	6,000.00	
Middle Tensas	2,000.00	
		$17,320.
From allotments in fourth district, 2 per cent:		
Lower Tensas	2,640.00	
Atchafalaya	3,040.00	
Lafourche	1,800.00	
Pontchartrain	3,000.00	
Barataria	1,200.00	
Lake Borgne	1,000.00	
		12,680.
Total available		30,000.
July 1, 1895, balance available		30,000.

PONTCHARTRAIN LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), i $149,873.39, distributed as follows:

Office expenses (main office)	$5,931. 4
Other administrative expenses	4,420. 9
Construction of levees	136,650. 1
Repairs to levees	969. 8
Protection to levees	395. 2
Steamers	549. 8
Surveys	731. 4
Repairs to plant	206. 2
Care of plant	12. 0
New plant	6. 3
Total	149,873. 39

Money statement.

June 1, 1894, balance unexpended		$2,282.03
Amount allotted from appropriation, act of August 17, 1894	$150,000.00	
Transferred from Atchafalaya levee district	4,633.04	
		154,633.04
Amount allotted from appropriation, act of March 2, 1895	150,000.00	
Transferred to Homochitto levee district	3,000.00	
		147,000.00
Balance available		303,915.07
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repairs	149,478.19	
Protection	395.20	
		149,873.39
July 1, 1895, balance unexpended		154,041.68
July 1, 1895, amount covered by uncompleted contracts		28,185.99
July 1, 1895, balance available		125,855.69

LAKE BORGNE LEVEE DISTRICT.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $45,859.11, distributed as follows:

Office expenses (main office)	$1,215.59
Other administrative expenses	3,822.65
Construction of levees	38,477.63
Repairs to levees	372.57
Protection to levees	130.10
Steamers	969.00
Surveys	824.70
Repairs to plant	.75
Care of plant	15.85
New plant	30.27
Total	45,859.11

Money statement.

June 1, 1894, balance unexpended		$7,758.98
Amount allotted from appropriation, act of August 17, 1894		50,000.00
Amount overpaid on voucher		1.50
Amount allotted from appropriation, act of March 2, 1895	$50,000.00	
Transferred to Homochitto levee district	1,000.00	
		49,000.00
Balance available		106,760.48
Amount expended from June 1, 1894, to June 30, 1895:		
Construction and repair of levees	45,729.01	
Protection	130.10	
		45,859.11
July 1, 1895, balance unexpended		60,901.37

SURVEYS, GAUGES, AND OBSERVATIONS.

The usual discharge measurements were not made during the high water of 1894 at Carrollton, at Red River Landing, and at Simmesport, on the Atchafalaya, as the stage of the river did not make it necessary.

Special surveys have been made at the mouth of Red River, in New Orleans Harbor, in the Homochitto levee district, in Giles Bend, near Natchez, and at various points in Warren County, Miss., where landowners have brought suit against the United States for alleged damage to their lands by reason of increased flood heights.

There were no difficulties of navigation in the main river channel in this district during the low-water season and no channel depths less than 10 feet reported, except at Fords, below Natchez, where a depth of 7 feet was reported for a few days.

The amount expended from June 1, 1894, to June 30, 1895 (thirteen months), is $7,440.39, distributed as follows:

Office expenses (main office)	$1,560.41
Other administrative expenses	544.80
Subsistence	519.27
Steamers	863.06
Surveys	3,447.63
Repairs to plant	233.15
Care of plant	254.36
New plant	17.71
Total	7,440.39

Money statement.

June 1, 1894, balance unexpended	$10,830.80
Amount allotted from appropriation act of August 17, 1894	12,000.00
Amount allotted from appropriation act of March 2, 1895	10,000.00
Balance available	32,830.80
Amount expended from June 1, 1894, to June 30, 1895	7,440.39
July 1, 1895, balance unexpended	25,390.41

The following maps and drawings accompany this report, as also a table of private levees in this district, compiled under the direction of Capt. John Millis, Corps of Engineers:

Plate I.—Natchez and Vidalia harbors.
II.—Part of New Orleans harbor.
III.—Lower Tensas and Homochitto levee districts.
IV.—Atchafalaya, Lafourche, and Pontchartrain levee districts.
V.—Barataria and Lake Borgne levee districts.
VI.—Profile Lower Tensas levee district.
VII.—Profile Atchafalaya levee district.
VIII.—Profile Lafourche levee district.
IX.—Profile Barataria levee district.
X.—Profile Pontchartrain levee district.
XI.—Profile Lake Borgne levee district.

Very respectfully, your obedient servant.

GEO. McC. DERBY,
Captain of Engineers.

Lieut. Col. GEO. L. GILLESPIE,
Corps of Engineers, United States Army,
President Mississippi River Commission.

Approximate value of plant belonging to the United States and used upon the improvement of the Mississippi River, fourth district, May 1, 1895.

Class of property.	Value.	Class of property.	Value.
Steamer General Newton	$5,000	Launch Lotus	$300
Steam launch Ruby	3,000	One warehouse barge	1,500
Steam tug General Comstock	6,000	.....do	50
Steam tug Tilda	6,000	Fifteen rowboats	200
Steam launch Alaska	2,500	Tools and appliances	17,000
Steam launch No. 5	1,500	Office furniture	2,000
One dredge boat Pah-Ute	3,000	Surveying instruments	2,500
One dredge boat The Ram	63,000	Drawing instruments	200
Four dump scows	4,000	Railway cars and tracks	1,000
Five quarter boats	14,000		
Twenty-five barges	50,000	Total	182,750

COMMERCIAL STATISTICS.

Statement showing the approximate receipts and shipments of freight by river from May 1, 1894, to May 1, 1895.

[Compiled from information obtained from commercial exchanges, the representative towns and the several business houses and landings where steamboats receive and discharge cargoes, and from records of the custom-house port of New Orleans, La.]

NATCHEZ, MISS.

Articles.	Receipts.			Shipments.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Cotton.....bales..	9,000	2,250	$337,500.00	5,000	1,250	$187,500.00
Cotton seed.....sacks..	70,000	3,500	31,500.00	.....	.....	.....
Coal.....bushels..	987,500	34,182	98,749.82	875,000	30,287	87,497.80
Flour.....barrels..	14,500	1,566	43,500.00	8,000	864	24,000.00
Corn.....sacks..	5,000	350	6,250.00	75,000	5,250	93,750.00
Oats.....do....	80,000	7,200	177,600.00	65,000	5,850	144,300.00
Lumber.....feet, B. M..	3,200,000	4,083	27,800.00	.....	.....	.....
Miscellaneous.....packages..	56,625	5,198	162,195.25	201,831	13,378	463,232.75
Total.....	.....	58,329	885,095.07	.....	56,879	1,000,280.55

For comparison the statistics for 1893 and 1894 are also given.

Statement showing the approximate receipts and shipments of freight by river, etc.—Cont'd.

NATCHEZ, MISS.—Continued.

	1893.	1894.	1895.
Steamboats in the trade	29	20	19
Times arrived	828	816	752
Times departed	828	816	752
Barges	45	70	57
Total cargo received.....tons..	123,784	87,560	58,329
Value of same	$1,469,089	$1,389,676	$885,095.07
Total cargo shipped.....tons..	26,394	76,333	56,879
Value of same	$1,168,371	$1,715,946	$1,000,280.55
Total cargo shipped and received.....tons..	150,178	164,893	115,208
Value of same	$2,637,360	$3,096,622	$1,885,375.62

VIDALIA, LA.

Receipts and shipments.

Articles.	Quantity.	Tonnage.	Value.
Cotton.....bales..	5,200	1,300	$195,000
Cotton seed.....sacks..	30,000	1,500	13,500
Corn.....do....	2,600	182	3,250
Flour.....barrels..	2,500	270	7,500
Molasses.....do....	180	32	1,530
Lumber.....feet, B. M..	170,000	216	1,530
Oats.....sacks..	5,900	531	13,098
Sugar.....barrels..	500	83	5,025
Staves (oak).....number..	130,000	2,250	25,200
Miscellaneous.....packages..	15,280	1,342	210,881
Total.....	.....	7,706	476,514

For comparison the statistics for 1893 and 1894 are also given.

	1893.	1894.	1895.
Steamboats in the trade	229	20	28
Times they have landed	828	730	678
Barges	3	8	10
Total cargo received and shipped.....tons..	11,540	7,318	7,706
Value of same	$467,060	$421,081.50	$476,514

BAYOU SARA, LA.

Articles.	Receipts.			Shipments.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Cotton.....bales..	730	183	$27,375.00	5,000	1,250	$187,500.00
Cotton seed.....sacks..	.....	.....	.....	95,000	4,750	42,750.00
Corn.....do....	3,200	224	4,000.00	4,100	237	5,125.00
Coal.....bushels..	400,000	13,846	39,999.96	300,000	10,385	29,999.84
Flour.....barrels..	4,500	486	13,500.00	4,000	432	12,000.00
Lumber.....feet, B. M..	20,000	26	180.00	170,000	217	1,530.00
Molasses.....barrels..	500	89	4,250.00	18	4	153.00
Oats.....sacks..	9,000	864	19,980.00	13,200	1,138	29,304.00
Rice.....barrels..	200	36	2,662.50	500	89	6,666.25
Sugar.....do....	2,500	419	25,125.00	630	112	6,709.50
Cotton ties.....bundles..	930	23	697.50	520	13	390.00
Miscellaneous.....packages..	51,458	3,630	178,561.10	47,475	3,992	293,797.00
Total.....	.....	19,826	316,331.06	.....	22,619	615,924.59

For comparison the statistics for 1893 and 1894 are also given.

Statement showing the approximate receipts and shipments of freight by river, etc.—Cont'd.

BAYOU SARA, LA.—Continued.

	1893.	1894.	1895.
Steamboats in trade	36	28	27
Times arrived	894	882	830
Times departed	894	882	830
Barges	23	32	23
Total cargo received.....tons..	14,438	14,851	19,826
Value of same	$307,892	$248,764	$316,331.06
Total cargo shipped.....tons..	10,420	12,788	22,619
Value of same	$278,537	$363,691	$615,924.59
Total cargo received and shipped.....tons..	24,858	27,649	42,445
Value of same	$586,429	$612,455	$932,255.65

BATON ROUGE, LA.

Articles.	Receipts.			Shipments.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Cotton.....bales..	1,000	250	$37,500.00	15,000	3,750	$862,500.00
Cotton seed.....sacks..	170,000	8,500	76,500.00	4,000	200	1,800.00
Cotton-seed meal.....do....	.....	.....	.....	2,000	100	1,500.00
Corn.....do....	6,000	320	13,320.00	3,000	210	6,000.00
Coal.....bushels..	8,175,000	282,980	817,500.00	6,540,000	255,814	654,000.00
Flour.....barrels..	100,000	10,800	300,000.00	25,000	2,700	75,000.00
Lumber.....feet, B. M..	.....	.....	.....	3,500,000	2,183	31,500.00
Molasses.....barrels..	10,000	1,785	85,000.00	40,000	7,140	340,000.00
Moss.....bales..	8,000	1,200	48,000.00	1,000	150	6,000.00
Oats.....sacks..	7,500	675	16,650.00	75,000	6,250	166,500.00
Rice.....barrels..	1,000	177	13,312.50	800	142	10,650.00
Sugar.....do....	5,000	837	50,250.00	2,500	418	25,125.00
Cotton-ties.....bundles..	10,000	250	7,500.00	1,000	25	750.00
Miscellaneous...packages..	511,148	28,839	1,672,788.00	1,366,000	27,736	1,202,282.50
Total.....	.....	347,113	3,138,320.50	.....	306,818	3,178,207.50

For comparison the statistics for 1893 and 1894 are also given.

	1893.	1894.	1895.
Steamboats in the trade	32	26	26
Times arrived	980	875	875
Times departed	980	875	875
Barges	165	203	125
Total cargo received.....tons..	98,614	58,169	347,113
Value of same	$1,973,052.00	$1,938,195.75	$3,138,320.50
Total cargo shipped.....tons..	140,522	88,998	306,818
Value of same	$2,111,542.00	$2,135,958.00	$3,178,207.50
Total cargo received and shipped.....tons..	239,135	147,167	653,931
Value of same	$4,084,594.00	$4,074,153.75	$6,316,528.00

PLAQUEMINE, LA.

Articles.	Receipts.			Shipments.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Corn.....sacks..	7,500	525	$9,375.00	3,500	245	$4,375.00
Coal.....bushels..	1,755,000	60,750	175,500.00	2,225,000	77,019	222,499.94
Lumber.....feet, B. M..	.....	.....	.....	2,060,420	2,659	18,543.78
Flour.....barrels..	14,000	1,512	42,000.00	3,000	324	9,000.00
Molasses.....do....	600	107	5,100.00	7,500	1,338	26,250.00
Moss.....bales..	35	5	210.00	1,500	275	9,000.00
Oats.....sacks..	8,500	765	18,870.00	5,500	495	12,210.00
Rice.....barrels..	1,800	319	23,961.50	2,500	443	33,281.25
Sugar.....do....	1,800	301	18,090.00	7,000	1,172	70,350.00
Miscellaneous.....packages..	74,728	5,691	487,227.75	602,162	5,888	99,667.66
Total.....	.....	69,975	780,334.25	.....	89,858	505,177.63

For comparison the statistics for 1893 and 1894 are also given.

Statement showing the approximate receipts and shipments of freight by river, etc.—Cont'd.

PLAQUEMINE, LA.—Continued.

	1893.	1894.	1895.
Steamboats in the trade	39	25	27
Times arrived	560	290	394
Times departed	560	290	394
Barges	30	34	28
Total cargo received, tons	24,137	17,901	69,975
Value of same	$595,423.00	$732,141.50	$780,334.25
Total cargo shipped, tons	62,393	45,597	89,858
Value of same	$1,254,614.00	$469,024.50	$505,177.63
Total cargo received and shipped, tons	86,530	63,498	159,833
Value of same	$1,850,037.00	$1,201,166.00	$1,285,511.88

DONALDSONVILLE, LA.

Articles.	Receipts.			Shipments.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Corn, sacks	8,000	560	$10,000.00			
Coal, bushels	2,300,000	79,615	229,999.90	1,800,000	62,207	$180,000.00
Flour, barrels	1,200	129	3,600.00			
Lumber, feet, B. M.	5,000	6	54.00			
Oats, sacks	10,000	900	22,200.00			
Rice, barrels	1,800	319	28,755.00			
Miscellaneous, packages	24,322	1,919	148,721.45	8,780	459	27,684.00
Total		83,448	443,330.35		62,766	207,684.00

For comparison the statistics for 1893 and 1894 are also given.

	1893.	1894.	1895.
Steamboats in the trade	42	29	31
Times arrived	835	575	783
Times departed	402	575	783
Barges	121	80	92
Total cargo received, tons	122,805	107,127	83,448
Value of same	$604,589.00	$511,773.50	$443,330.35
Total cargo shipped, tons	174,652	152,153	62,766
Value of same	$4,008,782.00	$4,288,284.50	$207,684.60
Total cargo received and shipped, tons	296,457	259,280	146,214
Value of same	$4,613,331.00	$4,800,058.00	$651,014.95

NOTE.—The deficit in net tonnage and values is due to the fact that in previous years there was a United States sugar inspector stationed at Donaldsonville, and all sugar and molasses from plantations was shipped through Donaldsonville. But owing to no bounty this year there was no inspector and the sugar and molasses was shipped by river direct from the respective plantations.

The above towns are, strictly speaking, "way points" and not termini, and the net tonnage or carrying capacity of the steamboats that do business at these places is not given.

Amount and value of commerce passing out of Red River and its tributaries through Old River into the Mississippi River.

[Compiled from the river column of the New Orleans Daily States and from information furnished by the courtesy of the commercial exchanges of New Orleans, La.]

OLD RIVER.

Articles.	Quantity.	Tonnage.	Value.
Coal ..... bushels..	3,619,200	125,280	$361,920.00
Cotton ..... bales..	104,139	26,035	3,898,004.50
Cotton seed ..... sacks..	18,604	10,052	90,468.00
Cotton-seed meal ..... do....	64,366	3,218	48,270.00
Cotton-seed oil ..... barrels..	2,269	511	7,665.00
Lumber ..... feet, B. M..	17,793,767	21,050	137,072.63
Molasses ..... barrels..	5,406	965	45,822.00
Moss ..... bales..	1,757	264	10,540.00
Rice ..... sacks..	4,089	368	11,357.50
Sugar ..... hogsheads..	1,786	237	10,943.50
Do ..... barrels..	15,410	2,751	165,041.10
Staves (oak) ..... number..	560,291	7,004	78,440.74
Miscellaneous ..... packages..	17,787	51,980	64,348.48
Total	.....	249,715	4,929,893.45

For comparison the statistics for 1893 and 1894 are also given.

	1893.	1894.	1895.
Steamboats in trade	17	20	13
Trips made by them	242	231	211
Net tonnage of same	73,571	69,841	52,750
Barges	19	7	160
Net tonnage of same	18,050	6,650	125,280
Total tonnage of steamboats and barges	91,621	76,491	178,030
Total cargo brought ..... tons..	53,858	74,156	249,715
Value of same	$4,168,847.00	$4,155,740.00	$4,929,893.45

NOTE.—This does not include the upstream freights, which must be nearly equal to the downstream in value.

Receipts by river at New Orleans, La., compiled from the river column of the New Orleans Daily States and from information furnished by the commercial exchanges of New Orleans, La.

Articles.	Above the city.			Below the city.		
	Quantity.	Tonnage.	Value.	Quantity.	Tonnage.	Value.
Coal ..... bushels..	10,005,200	246,333	$1,000,519.78	.....	.....	.....
Cotton ..... bales..	278,014	69,457	10,389,566.00	.....	.....	.....
Cotton seed ..... sacks..	715,210	43,667	402,003.00	.....	.....	.....
Cotton-seed meal ..... do....	118,306	7,105	106,725.00	.....	.....	.....
Cotton-seed oil .... barrels..	73,054	1,659	24,885.00	.....	.....	.....
Flour ..... do....	220,347	23,512	661,041.00	.....	.....	.....
Flour ..... half barrels..	41,478	2,240	67,401.75	.....	.....	.....
Corn ..... bushels..	5,123,893	143,469	2,561,946.50	238	7	$119.00
Oats ..... do....	519,922	8,319	192,371.14	756	12	279.72
Lumber ..... feet, B. M..	23,371,072	35,408	176,125.47	.....	.....	.....
Molasses ..... barrels..	227,742	40,652	2,934,542.25	2,988	533	24,651.00
Moss ..... bales..	5,119	768	30,714.00	674	101	4,044.00
Rice (clean) ..... barrels..	99	18	1,317.93	.....	.....	.....
Rice ..... sacks..	109,631	9,867	304,545.00	15,868	635	44,077.50
Sugar ..... hogsheads..	44,806	54,647	1,116,181.69	853	540	24,952.91
Sugar ..... barrels..	579,791	107,493	6,209,561.61	19,975	3,566	213,932.25
Staves (oak)	1,621,238	13,262	226,973.32	.....	.....	.....
Wheat ..... bushels..	1,095,969	32,879	712,379.85	.....	.....	.....
Miscellaneous ... packages..	723,266	51,980	1,642,021.70	216,395	18,397	374,590.62
Total	.....	992,735	28,760,821.99	.....	23,791	686,647.00

Receipts by river at New Orleans, La., etc.—Continued.

	Above the city.			Below the city.		
	1893.	1894.	1895.	1893.	1894.	1895.
Steamboats	51	57	51	6	3	2
Trips made by them	1,203	1,253	986	266	159	180
Net tonnage of same	542,156	522,775	483,140	26,077	16,867	11,880
Towboats	32	44	33	.....	.....	.....
Trips made by them	108	123	89	.....	.....	.....
Net tonnage of same	46,357	50,780	30,838	.....	.....	.....
Barges	568	733	500	.....	.....	.....
Net tonnage of same	255,600	329,850	225,000	.....	.....	.....
Number of luggers (sailing in local trade)	25	44	17	100	241	271
Trips made by them	650	516	180	2,600	2,673	2,684
Net tonnage of same	3,900	3,096	1,080	15,600	16,038	18,788
Total tonnage of steamboats, towboats, barges, and luggers	848,013	906,501	740,058	*41,677	*32,905	*30,668
Total cargo brought, tons	806,846	1,013,543	992,735	37,652	17,453	23,791
Value of same	$27,662,765	$30,487,993	$28,760,821.99	$759,551	$1,415,627	$686,647

* Steamboats and luggers.

RECAPITULATION.

	1893.	1894.	1895.
Total arrivals (steamboats, towboats, barges, and luggers) above and below the city	5,395	4,723	4,619
Total net tonnage above and below the city	889,690	938,406	770,726
Total cargo brought above and below the city..tons	844,498	1,031,001	1,016,526
Value of same	$28,422,216.00	$31,903,620.00	$29,447,468.99

The foregoing includes simply the freights brought to New Orleans by steamboats, barges, and luggers on the Mississippi River, and does not include the freights that they take away. No correct account is kept of this and it is impossible to furnish even a reasonably accurate estimate of its value. It would amount to a considerable sum in the aggregate, possibly 40 per cent of the value of freights received at New Orleans, La.

Foreign commerce, port of New Orleans.

The statistics relating to the foreign commerce of the port of New Orleans were kindly furnished by Hon. T. S. Wilkinson, collector of customs.

Vessels.	Entrances.			Clearances.		
	1892-93.	1893-94.	1894-95.	1892-93.	1893-94.	1894-95.
Steam	1,131	843	1,176	1,084	850	1,092
Sail	135	71	91	135	60	72
Total	1,266	914	1,267	1,194	910	1,164

Total tonnage of above.

1892-93	2,962,798
1893-94	2,074,118
1894-95	3,142,202

Exports and imports.

	1893.	1894.	1895.
Total value of exports to foreign countries:			
Foreign merchandise	$478,993.00	$310,319.00	$319,200.00
Domestic merchandise	81,812,507.00	82,769,096.00	67,393,845.00
Total	82,291,500.00	83,079,415.00	67,713,045.00
Total value of imports from foreign countries:			
Free	22,907,192.00	16,022,352.00	10,983,592.00
Dutiable	3,912,923.00	2,979,404.00	3,193,362.00
Specie	596,458.00	433,039.00	434,200.00
Total	27,416,573.00	23,434,795.00	14,611,154.00
Total duties collected	1,509,309.12	1,257,418.61	1,088,812.91

List of civilian engineers employed on work of river and harbor improvements, fourth district, improving Mississippi River, from May 1, 1894, to May 1, 1895, in charge of the following officers of the Corps of Engineers: Capt. John Millis, from May 1 to October 31, 1894; Maj. James B. Quinn, to November 23, 1894, and Capt. George McC. Derby, to May 1, 1895.

Name and residence.	Time employed.	Compensation per month.	Where employed.	Work on which employed.
	Mos.			
H. S. Douglas, Natchez, Miss.	12	$200	Natchez, Miss	Levees, lower Tensas levee district, survey Homochitto levee district, improving harbor at Natchez and Vidalia, Miss. and La.
W. J. Hardee, Baton Rouge, La.	12	200	Baton Rouge, La.	Levees, Atchafalaya, Lafourche, and Pontchartrain levee districts.
William Garvin, New Orleans, La.	12	175	New Orleans, La.	Improving harbor at New Orleans, La.
E. B. Geddes, Natchez, Miss.	4	140	Natchez, Miss	Improving harbor at Natchez and Vidalia, Miss. and La.
Do	8	150	do	Do.
A. F. Woolley, jr., New Orleans, La.	4 3/30	140	New Orleans, La., and Old River, La.	Surveys, gauges, and observations, improving Atchafalaya and Red rivers, Louisiana.
Do	7 27/30	150	do	Do.
John Smyth, jr., New Orleans, La.	4	140	New Orleans, La.	Levees, Lake Borgne and Barataria levee districts.
Do	8	150	do	Do.

APPENDIX 7 A.

REPORT OF MR. H. S. DOUGLAS, ASSISTANT ENGINEER, IN LOCAL CHARGE OF IMPROVING HARBORS AT NATCHEZ AND VIDALIA, MISSISSIPPI AND LOUISIANA.

NATCHEZ, MISS., *May 1, 1895.*

SIR: I have the honor to submit the following report on the work of improving the harbors at Natchez and Vidalia, Mississippi and Louisiana, for the period from May 1, 1894, to May 1, 1895:

On May 1, 1894, no construction had been undertaken. A project had been approved for the construction of a spur levee, commencing at the bluffs, on the neck of land above Natchez, to prevent the threatened cut-off by the flow of water across the neck during flood stages of the river. The line of this levee had been located and surveyed, but construction had been prevented by the owner of the land refusing to either donate the right of way or accept a reasonable compensation therefor. In consequence, proceedings to have the necessary amount of land condemned had been commenced through the Department of Justice.

In the meanwhile an additional appropriation of $80,000 was made, and a further project for the expenditure of this amount and the balance of the previous appropriation was submitted and approved. This project provided for the construction of 10 decked barges, the purchase and delivery of 12,000 tons of rock, and a survey to determine the locality where bank protection was most urgently required.

After considerable delay the Department of Justice succeeded in having the necessary right of way condemned, and construction of the spur levee by contract was commenced October 23, 1894. The levee was rather a large affair, being 19,500 feet long and containing 267,809.94 cubic yards of earthwork. It was divided for pur-

poses of letting to contractors into four sections, designated as A, B, C, and D. Details of contract work are given in the table herewith.

Levee on Cowpen Point.

Section.	Contractor.	Length.	Grade above high water, 1892.	Section.		Net fill.		
				Crown.	Side slopes.	Least.	Greatest.	Average.
		Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
A	Eltringham Construction Co	5,100	3	8	2.5 to 1	0.6	15.6	10.3
B	.....do.....	2,800	3	8	2.5 1 3 1	7.7	22.5	13.2
C	Lamb & Carry.....	3,800	3	8	3 1 2.5 1	6.6	15.9	11.2
D	Edwin B. Helgason.....	7,300	3 to 1.5	8	2.5 1 5 1	2.7	14.2	8.2

Contractor.	Embankment.		Filled excavations.		Contract time for completion.	Work commenced.	Work completed.
	Cubic yards.	Price per cubic yard.	Cubic yards.	Price per cubic yard.			
		Cents.		*Cents.*			
Eltringham Construction Co.....	65,898.87	10	None.	10	Mar. 1, 1895	Dec. 22, 1894	Feb. 26, 1895
Do.....	65,145.10	11	1,693.60	11	.....do.....	Dec. 1, 1894	Do.....
Lamb & Carry.....	65,107.61	11.5	884.10	11.5	.....do.....	Oct. 23, 1894	Jan. 22, 1895
Edwin B. Helgason....	63,761.86	11.5	5,318.80	11.5	.....do.....	Nov. 5, 1894	Feb. 9, 1895

The levee does not differ materially from other levees in the district except that the slopes were uniform on both sides. The outer end terminates in a 30° curve 300 feet long, and the side slopes of the curved portion were flattened to 5 to 1. The project provided that the end of the levee be revetted with brush to prevent wash by water flowing around it during floods. This revetment was constructed by hired labor.

The quarter boat *Delta*, with tools and necessary outfit for quartering and subsisting a force of about 50 men, left New Orleans January 4, 1895, in tow of the tug *General Comstock*, and arrived at Natchez January 9, 1895, where she was laid up in care of watchman until the contractor finished the embankment ready for the revetment. Meanwhile the force was organized, and on January 28 was placed on board and the quarter boat towed to the most convenient locality for the work, which was commenced at once.

The revetment was constructed as follows: Light piles of 4 by 4 inch lumber were driven into the slopes of the levee and out on the berme for about 20 feet beyond the foot of the slope. These piles had a penetration of from 6 to 8 feet and were allowed to project about 2 feet above the surface. They were spaced 6 feet between centers. Between these piles layers of willow brush, crossing each other, were laid until a thickness of about 18 inches had been attained. Then stringers or caps made of two pieces of 2 by 4 inch scantling, with 4-inch blocks between, were dropped over the projecting heads of the 4 by 4 inch piles and squeezed down with a tool known as a "mattress jack." The caps were secured to the piles by 9-inch wire spikes and No. 10 galvanized wire. The interstices in the brush were then filled in with earth and dressed off to a smooth surface. The revetment commences on the straight portion of the levee 100 feet back of the curve and extends over the upper face or slope of the curve, around the end, and back for 100 feet on the inner or concave side of the curve. The length of revetment is 600 feet and it has an average width of 50 feet, the exact area being 29,541 square feet. This work was completed March 2.

Quantities and value of material and cost of labor were as follows:

10,000 feet, B. M., lumber, at $12	$120.00
350 cords of willow brush, at $1.53	535.50
150 pounds No. 10 galvanized wire, at 2.35 cents	3.53
200 pounds No. 9 steel wire nails, at 2.5 cents	5.00
200 pounds No. 6 steel wire nails, at 1.95 cents	3.90
Labor, superintendence, etc	1,332.05
Provisions and fuel	508.40
Total	2,508.38
Square feet of revetment built	29,541
Cost per square foot	$0.0849

The material of which the levee is built, especially Section D, was loose sand. Shortly after completion by the contractors heavy rains washed the embankment badly and extensive repairs were necessary. These repairs were made by hired labor, after the completion of the revetment. The length of levee repaired was 7,300 feet, and the total cost of this work was $1,175.35. All construction for the season was completed March 31.

No tools were lost or destroyed in the prosecution of the work, and as the quarter boat was well equipped from stock on hand, the cost of additional tools purchased for the work was nominal amounting to only $18.20.

While surveys for works of improvement can generally be made to the best advantage at low water, the river was so unusually low for the season of the year when the revetment and repair work was completed that it was decided to begin the survey provided for in the project. The survey was accordingly commenced April 1 and is now in progress. The river has remained at about a half stage and it seems probable that the survey will be completed shortly.

Contracts have been made for the delivery of 12,000 tons of rock and for the construction of the decked barges provided for in the project. The rock contractor has commenced the installation of his plant for obtaining the rock at his quarry near Grand Gulf, Miss. Construction of the barges is in progress at Cincinnati, Ohio.

Assistant Engineer E. B. Geddes has been in immediate charge of the construction of the spur levee, revetment work, repairs to levee, and the survey. He has been assisted by such inspectors, master laborers, timekeepers, rodmen, etc., as were necessary from time to time.

At the close of this report the condition of the work and plant is as follows:

The spur levee is generally in fair condition, but is in need of further repairs in the way of filling up rain washes, resodding in places, cutting off weeds and briers, etc. The revetment is in good condition. There has been considerable caving of the bank on the upper side of the neck of land, reducing the width of the point materially. In Marengo Bend caving has been phenomenally rapid, and commences to threaten the U. S. Lake Concordia levee built on the west bank of the lake.

The quarter boat *Delta* has been used for quartering and subsisting the necessary force for revetment, repair, and survey work. The boat is in good condition.

The tug *General Comstock* has been used as a general-service boat, moving quarter boat *Delta*, and on survey of Natchez Harbor. Repairs to hull and machinery are required before being employed on heavy work.

Very respectfully, your obedient servant,

H. S. DOUGLAS, *Assistant Engineer.*

Capt. GEO. MCC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 B.

REPORT OF MR. A. F. WOOLLEY, JR., ASSISTANT ENGINEER, IN CHARGE OF IMPROVING ATCHAFALAYA AND RED RIVERS, LOUISIANA.

NEW ORLEANS, LA., *May 1, 1895.*

SIR: I have the honor to submit the following report on the works under my local charge for the period from May 1, 1894, to May 1, 1895:

JUNCTION OF THE MISSISSIPPI, ATCHAFALAYA, AND RED RIVERS, NEAR TURNBULL ISLAND, LOUISIANA.

A detailed description of the difficulties in this vicinity, with the proposed improvements for their rectification, was given in the annual report of 1892 and again briefly enumerated in the annual report of 1894.

DREDGING OPERATIONS IN LOWER OLD RIVER.

The season during which dredging is a necessary resort to maintain navigation ordinarily comprised in the months between June and November, depending entirely on the period of low-water stage, it never being necessary above medium stages.

The conditions which attended the seasons of 1894 and 1895 in some respects were more favorable than for many years past, in view of the fact that there was a complete absence of sloughing banks, which is attended by a corresponding upheaval in the bottom of the channel; therefore the only obstruction to be encountered was the drifting sand which comes in from the Mississippi.

This sand is carried into Old River to a distance and in quantities varying with the velocity of the current, which is in turn quite erratic and dependent on the fluctuating stages of the Mississippi and Red rivers.

The direction of the current is not infrequently reversed for short periods, thereby aggravating this evil from drifting sand, a portion of which would pass out of Old River entirely if the current had a fixed direction.

The entire absence of sloughing banks and a corresponding upheaval in the bottom of the channel I attribute almost if not entirely to the draining of the lakes and sloughs, most of which are situated in the partially filled basin which formerly composed the channel of the Mississippi.

The localities at which most trouble was experienced, given in their relative order with regard to the difficulty of maintaining a channel through them, are:

(1) Foot of Turnbull Island to Dead Tree, a distance of 1½ miles. The bottom of the channel throughout this distance was in many places from 1.5 to 2 feet above the zero of Barbre's gauge when dredge began operations.

(2) Second Crossing, about one-half mile below Turnbull Island. When dredge began operations there was at this locality a stretch of 1,000 feet in which the bottom of the channel averaged 1.5 feet above the zero of Barbre's guage.

(3) Mouth to First Crossing, a stretch of 1,500 feet, through which the bottom of the channel was 1.5 feet above the zero of Barbre's gauge when dredge began operations.

Dredging was required at certain intervals and for short periods at Ash Cabin, Chandlers Warehouse, and Barbres Light.

The dredge *Ram* left New Orleans on May 14, 1894, and upon arrival at Old River it was found that the water was too high to begin dredging. The crew was engaged in calking pontoon and reopening drain ditches from lakes and sloughs into Old River until June 5, when dredge *Ram* was placed at work with Barbre's gauge reading 27.60 feet above zero.

About the middle of July the water was so rapidly approaching a low stage and the amount of dredging still necessary to obtain a desired depth of channel, it was decided to place a double crew on the *Ram* and to have the dredge *Pah-Ute* assist the *Ram*.

A double crew was placed on the *Ram* July 30, and the work prosecuted without cessation day or night, crews changing watch every six hours, Sundays excepted, it being necessary to cool down at least once a week to wash boilers and keep machinery in good repair.

On September 21 such headway in securing and maintaining a desirable depth of channel had been made that it was decided to discontinue double crew and night work.

This nightwork proved to be a great hardship on the crew, as it was almost impossible for the crew not on watch to obtain sufficient rest to fit them for duty when on watch.

The dredge *Pah-Ute* was placed at work in Old River on July 30 and continued until September 3, then laid up until September 15 to make repairs to bucket chain, after which she was again placed at work, continuing throughout the season except such periods as were required to make repairs to bucket chain, these being quite frequent during the latter part of the season.

On January 4, 1895, all dredging operations were discontinued and dredges sent to New Orleans to lay up until next season and make such repairs as might have proved desirable from the experience obtained during this unusually long season.

I deem it worthy of mention here, by way of showing the efficiency of the self-propelling appliances of the dredge *Ram*, that she towed the *Pah-Ute*, launch *Lotus*, one large pontoon, and two coal lighters from Red Liver Landing to New Orleans, a distance of 200 miles, and at a time when the Mississippi was quite rough.

The steam launch *Lotus* served as tender to dredge during the season, and was used for coaling dredges, taking soundings, communicating with post-office and telephone at Barbres or Red River Landing.

Total number days worked by dredge *Ram*	200
Total number days lost by breakdowns	14
Approximate number cubic yards moved by dredge *Ram*	265,000
Approximate cost per cubic yard of material moved	$0.0476
Total number days worked by dredge *Pah-Ute*	108
Total number days lost by breakdowns	19
Approximate number cubic yards moved by *Pah-Ute*	50,000
Approximate cost per cubic yard of material moved	$0.0685

It will be seen from the foregoing that my estimate of the total number of cubic yards dredged by *Ram* and *Pah-Ute* during the season is placed at 315,000, and while these figures are liberal I do not consider them excessive in any particular, having been based on the following data, viz:

(1) On what I know to have been condition of channel at the beginning of the season as compared with the condition of the channel when dredging operations were discontinued.

(2) On the knowledge of the effective capacity of the dredges working through extended periods.

(3) On a liberal estimate of the amount of sand which is washed in from the Mississippi, this having to be added to the material to be moved in order to attain a required depth of channel.

I am unable to render more definite information, the work being under the immediate charge of the master of the dredges during the greater part of the season and no provision made for data sufficient to form an exact estimate of the total number of cubic yards moved during the season.

While immediately in charge of this work for a very limited period I was engaged on special survey duty in the vicinity during the greater part of the season, and had frequent occasion to visit localities where dredges were at work.

Navigation was maintained throughout the season of 1894–95, which was a remarkable one in view of the prolonged stage of extreme low water. On November 12, 1894, Red River Landing gauge read —0.25 and Barbre's gauge read —1.61, both of which are the lowest records for these gauges since their establishment.

Notwithstanding this prolonged and extreme low water, a navigable channel of 5 feet or more was maintained, with the exception of short periods when there was not a greater depth than 4.5 feet at Dead Tree or the Mouth.

Unless the ensuing season should be accompanied by extraordinary circumstances, there is every probability that the dredge *Ram* may keep Old River open without working continuously.

IMPROVING BAYOU DES GLAISES.

Bayou des Glaises is an affluent of the Atchafalaya; its mouth is situated at Simmesport, La., fed during its lower stages by lakes and small bayous in the vicinity of Cottonport, La., a distance of 50 miles from its mouth; fed during its higher stages by overflow from the Red or by backwater from the Atchafalaya; is not navigable at all during its lower stages. Navigable for a distance of 25 miles at medium stages and for 52 miles during extreme high stages of the Red and Atchafalaya rivers.

There is a continuous system of levée along its west bank, maintained by the State of Louisiana.

This stream is the only feasible means of transportation for the products of 50 square miles of cultivated lands situated immediately on its banks.

The commercial value of agricultural products, together with the timber interests, is about $450,000 annually. There is but one boat regularly engaged in this trade, though several towboats with barges make occasional trips during the navigable season.

An allotment of $2,500 was set aside for improvements.

Improvement consisted of cutting overhanging timber, underbrush, blowing stumps and snags, and removing same. It was not possible to clear the whole bayou with the small allotment available; therefore it was decided to clear that portion which offered the most serious obstruction first, and then after the water reached a sufficient stage to tow out the floating material where it existed in such quantities as would offer obstruction to navigation worthy of notice. Overhanging timber was cut between the mouth and a point 2 miles above Moreauville, a total distance of 39.25 miles.

All stumps and snags were blown out between the mouth and a point about 4 miles below Moreauville, a total distance of 33.25 miles. The floating material was removed between the mouth and a point 1 mile above Yellow Bayou, a total distance of 4 miles. The steamer *Ruby* was used for towing out the floating material. A small portion of the allotment was never expended, the water not remaining at a suitable stage sufficiently long to expend the amount retained for removal of floating material; however, everything has been removed where it existed in quantities sufficient to become a serious obstruction.

All large timber was cut into such lengths as to readily float out where it existed in small quantities, which was true for the greater part of the distance.

Cost of labor, dynamite, fuse, caps, and superintendence, and including cost of services of steamer *Ruby*	$2,107.10
Balance unexpended	392.90
Total allotment	2,500.00

REPAIRS.

Red River Dam.—This work consisted of paving the bottom of a deep hole and the slope of the bank immediately below the Turnbull Island shore end of the dam. While these repairs were not extensive they were rendered necessary by the scouring action of a strong current which pours over the dam.

There was no plant available for sinking a mattress, therefore the paving consisted of rock alone, the area to be paved being small. A portion of the rock left on hand when the building of the dam was suspended was used in making the repairs.

Cost of labor and superintendence, $450.87.

Sill dams in Atchafalaya River.—Minor repairs of the same nature as those for Red River Dam were made to the east shore end of the upper dam at Simmesport, La. The rock used for making these repairs was also obtained from the quantity stored on the bank at Red River Dam.

Cost of labor and superintendence, $111.50.

Surveys, mouth of Red River and vicinity.—These surveys embraced practically the same area as that covered by surveys of upper and lower Old River and a portion of Red River made in 1883 and 1884 and of the Atchafalaya in the vicinity of Simmesport, La., made in 1886 and 1887.

These surveys are to show the present conditions of upper Old River from the head to the foot of Turnbull Island, lower Old River from the mouth to the head of the Atchafalaya, of Red River from the head of Turnbull Island to the head of the Atchafalaya, of the Atchafalaya River in the vicinity of sill dams at Simmesport, La., of Red River Dam and Atchafalaya sill dams.

Field work was begun on September 26, 1894, and completed on April 6, 1895. From September 26 to January 17 the survey party consisted of myself, one transit man, one recorder, one rodman, one leadsman, and two skiffmen.

On January 17 the party was increased by the addition of one leveler, one rodman, and suitable number of laborers, this increase having been made in order to complete such portions of the work as should be carried out before the usual annual high water.

In upper Old River the 9 old sections used in survey of 1883 and 1884 were duplicated and 77 new sections established; levels were taken from top of bank to top of opposite bank on each section.

In lower Old River the 17 old sections used in survey of 1883 and 1884 were duplicated, 127 new sections were established, and levels and soundings taken on each section. In Red River the 7 old sections used in survey of 1883 and 1884 were duplicated, 24 new sections were established, and levels and soundings were taken on each section. In the Atchafalaya River the old sections used in the survey of 1886 and 1887 were duplicated and levels and soundings taken on each.

Eight sections above and eight sections below the limits of the survey of 1886 and 1887 were established and sounded to determine the condition of the Atchafalaya at points more remote from the dams.

From M. R. C. B. M. $1\frac{1}{2}$ at Torras Landing a true azimuth traverse line was run along the banks of lower Old River to Barbres and thence to a point one-half mile down the Atchafalaya River. This traverse line was marked by 27 iron pipes, the elevation of each being determined by Cairo datum, and all sections located by azimuth from these pipes so that they may be readily duplicated at any future date.

Maps of these surveys have not yet been completed and a full report can not be made until this has been done.

Briefly, the conditions existing in this vicinity at the date upon which these surveys were completed were as follows:

Upper Old River: The channel throughout its entire length averaged about 10 feet above zero of Barbres gauge.

Lower Old River from the mouth to foot of Turnbull Island: A channel depth of 5 or more below zero of Barbres gauge, with one exception of 200 feet near the mouth, through which there was 4.7 feet below zero of Barbres gauge.

From foot of Turnbull Island to Dead Tree: A channel depth of 7 feet or more below the zero of Barbres gauge.

Dead Tree to Ash Cabin: A channel depth of 6 feet or more below the zero of Barbres gauge.

Ash Cabin to Barbres: A channel depth of 10 feet or more below zero of Barbres gauge, with the exception of a short distance in the vicinity of Chandler's Warehouse, where there was not a greater depth than 8.2 feet below zero of Barbres gauge.

Red River Dam and Atchafalaya sill dams: In good condition after minor repairs above mentioned were made.

Very respectfully, your obedient servant,

A. F. WOOLLEY, Jr.,
Assistant Engineer.

Capt. GEO. McC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 C.

REPORT OF MR. A. F. WOOLLEY, JR., ASSISTANT ENGINEER, ON SURVEYS, GAUGES, AND OBSERVATIONS.

NEW ORLEANS, LA., *May 1, 1895.*

SIR: I have the honor to submit the following report on work done by me under the allotment for surveys, gauges, and observations for the period from May 1, 1894, to May 1, 1895:

Restricting flood heights.—Examination, surveys, and estimates were made to determine the practicability and approximate cost of restricting the flood heights of the Lower Mississippi.

The result of these investigations pointed to "relief openings" as the most practicable, least expensive, and with a greater certainty of beneficial results in proportion to the expenditure to be involved.

These openings were to be under control, were to be opened when the Mississippi reached a safe resisting limit of the levees, the length of opening to be fixed, to be closed by an ordinary levee of inferior section to the general levee system, to have diverging wing or protection levees leading from either end back to the overflow basin.

Two locations for such openings have been considered, Kenner, La., 9.2 miles above, and Lake Borgne Canal, 7 miles below New Orleans, the former being the most favorably situated.

All of the features developed by these surveys and examinations, together with estimates and drawings showing proposed locations, were made the subject of special report to the president of the Commission by Capt. John Millis under date of June 23, 1894.

Very respectfully submitted.

A. F. WOOLLEY, JR.,
Assistant Engineer.

Capt. GEO. MCC. DERBY,
Corps of Engineer, U. S. A.

APPENDIX 7 D.

REPORT OF MR. WILLIAM GARVIN, ASSISTANT ENGINEER IN LOCAL CHARGE OF IMPROVING HARBOR AT NEW ORLEANS, LA.

NEW ORLEANS, LA., *May 3, 1895.*

SIR: I have the honor to submit the following report on the work of which I have been in local charge from May 1, 1894, to May 1, 1895. From May to October, 1894, the work was chiefly care and repair to plant at Government depot. During the latter part of October a willow-cutting force was put in operation at Point Breeze, La., and mattress construction was commenced in the third district, New Orleans, La., on November 5.

The operations of the past season in the third district bend, New Orleans Harbor, consisted in laying continuous mattress revetment from the lower edge of Dike No. 1 to upper edge of Dike No. 2, a distance of 1,020 feet. The foundation mattress, 400 by 120 by 2.5 feet, has been laid for Spurs Nos. 2½, 3½, 4, and 4½. A mattress 200 by 120 by 2.5 feet has been placed below Spur No. 2 and a mattress 200 by 150 by 2.5 feet has been placed below Spurs Nos. 3, 3½, 4, and 4½, adjoining the foundation mattress at its shore end.

The continuous revetment consisted of seven sections or mattresses, six of 400 by 150 by 2.5 feet and one of 400 by 120 by 2.5 feet.

Two set of shore mattress ways were built on the bank opposite the Ursulines Convent and the usual method of mattress building was followed, each section when launched being 100 feet in length by the required width. The required number of sections of the above dimensions are placed in position between rock barges and the frames connected with splices of timber reenforced by wire fastenings.

Construction was commenced November 5, 1894, and completed March 6, 1895. The first mat was sunk December 19, 1894, and the last March 9, 1895. The work finished, when suspended, consisted of building and sinking of mattresses as follows:

	Square feet.
Six mattresses, 400 by 150 by 2.5 feet, containing	360,000
Five mattresses, 400 by 120 by 2.5 feet, containing	240,000
Four mattresses, 200 by 150 by 2.5 feet, containing	120,000
One mattress, 200 by 120 by 2.5 feet, containing	24,000
Total number of square feet	744,000

The quantity and value of material used in construction was as follows:

Rock:	
4,770.49 tons, at $2.09 per ton	$9,970.32
2,258.24 tons, at $1 per ton	2,258.24
Lumber:	
3 by 6 inch, 61,161 feet, B. M., at $8.70 per M	532.10
3 by 6 inch, 57,041 feet, B. M., at $8.90 per M	507.66
2 by 4 inch, 140,327 feet, B. M., at $8.70 per M	1,220.84
2 by 4 inch, 65,117 feet, B. M., at $8.90 per M	579.54
2 by 4 inch, 59,339 feet, B. M., at $8.50 per M	504.38
Wire No. 10, black:	
4,592 pounds, at $1.87½ per 100 pounds	80.36
3,500 pounds, at $1.70 per 100 pounds	59.50
2,971 pounds, at $2 per 100 pounds	59.50
Nails:	
3½-inch, 500 pounds, at $2.05 per 100 pounds	10.25
4½-inch 1,595 pounds, at $1.53 per 100 pounds	24.40
6-inch, 1,620 pounds, at $1.60 per 100 pounds	25.92
6-inch, 2,800 pounds, at $1.28 per 100 pounds	35.84
9-inch, 780 pounds, at $2.40 per 100 pounds	18.72
9-inch, 4,000 pounds, at $1.78 per 100 pounds	71.20
Willow brush:	
6,419 cords, at $1.37044 per cord	8,796.85
2,686.28 cords, at $1.33 per cord	3,572.75
Willow poles:	
389 cords, at $1.37044 per cord	533.10
42.75 cords, at $2 per cord	85.50
Superintendence, crew of tugs, and labor	22,810.36
Provisions and ice	5,496.46
Coal for tugs and ranges	2,030.20
Miscellaneous, oils, tools, kitchen utensils, etc	1,248.10
Total	60,532.09

Cubic feet of mattress work	1,860,000
Square feet of mattress work	744,000
Pounds of rock per square foot to sink	18,894
Cost per square foot in place	$0.08136

In the past few years numerous bulkheads, brace piling, revetments, and one wharf have caved into the river along this front, and it was found necessary to remove these obstructions before sinking the mattresses, and more or less blasting and pulling was done over the entire space where mattresses were sunk. In doing this work a derrick barge and the tug *Tilda* were used for removing wreckage above the surface, and a diver with necessary outfit was employed for removing submerged obstructions. The cost of this work was:

Tug *Tilda*, derrick barge, and labor	$408.02
Diver with outfit, 19½ days, at $15 per day	292.50
Explosives	596.65
Coal and miscellaneous articles	116.36
Total	1,413.53

The removal of obstructions makes a total of $61,945.62 for field work in the third district bend, and would increase the cost of mattress work to $0.08326 per square foot.

The actual cost of mattress work when sunk in position was $0.007829 less than for work done in the Southport bend in the working season of 1892–93.

Survey was made in the third district bend extending from Dikes Nos. 1 to 5, all buildings and improvements near the levee were located, and the soundings extended well into channel of river. The entire cost of survey was $359.50.

All work previously completed in this bend remains in place and in good condition.

Survey was made in the Southport bend, the survey extending from Dikes Nos. 1 to 5. The entire cost of the survey was $247.34.

All dikes and mattress work in this bend remain in place and in good condition.

The quantity and value of material on hand on completion of work in third district was as follows:

Rock:	
1,172.27 tons, at $2.09 per ton	$2,450.04
390.72 tons, at $1 per ton	390.72

Nails:	
4½-inch, 625 pounds, at $1.53 per 100 pounds	$9.56
6-inch, 14,500 pounds, at $1.28 per 100 pounds	185.60
9-inch, 1,500 pounds, at $1 78 per 100 pounds	26.70
Lumber:	
3 by 4 inch, 37,891 feet, B. M., at $8.90 per M	337.22
2 by 4 inch, 11,661 feet, B. M., at $8.99 per M	103.78
Total value	3,503.62

The lumber and rock have been unloaded on the bank and the nails in warehouse at Government depot.

The value of tools and lines purchased was	$1,018.28
The value of tools lost was	15.00

In the tools purchased all manila and wire lines, shackles, and all nonexpendable property has been included, and the value of this property has been included in the cost of mattress work.

Of the rock used during the past season 4,770.49 tons was purchased from J. W. Worthington & Co., of Birmingham, Ala., the contract price being $2.09 per ton loaded on United States barges; 2,258.24 tons was purchased from vessels in the harbor, and the price paid was $1 per ton loaded on United States barges; 6,419 cords of willow brush and 389 cords of poles were cut by Government employees at Lums Bar, La., and 2,686.28 cords of brush and 42.75 cords of poles were cut by contractor on the river bank below New Orleans.

The cost of repairs to different parts of the plant at Government depot from May 1, 1894, to May 1, 1895, were as follows:

Steamer *General Newton:*	
New flues in boilers	$660.00
Paints, lumber, canvass, etc	163.46
Carpenters and labor	805.93
Total	1,629.39
Tug *General Comstock*—Repairs to machinery and hull:	
Repairs to machinery	129.50
Lumber and paints	25.70
Labor, carpenters, and calkers	229.47
Total	384.67
Tug *Tilda*—Repairs to machinery and hull:	
Repairs to machinery	4.18
Oakum, paint, lumber, etc	60.31
Labor, carpenters, and calkers	609.11
Total	673.60
Launch *Ruby*—Repairs to machinery and hull:	
Repairs to machinery	29.00
Lumber, iron, tiles, etc	55.21
Labor, carpenters, and calkers	353.79
Total	438.00
Quarter boat *Alpha*—Repairs to hull:	
Oakum	3.75
Labor and calkers	24.00
Total	27.75
Quarter boat *Beta*—Repairs to tanks:	
Labor	13.00
Quarter boat *Gamma*—Repairs to hull and painting:	
Lumber, paints, oakum, roofing, etc	479.80
Building end dock (one-half cost)	86.75
Labor, carpenters, calkers, and painters	437.25
Repair to ranges	22.75
Total	1,026.55

Quarter boat *Delta*—Repairs to hull and painting:	
Lumber, paints, oakum, roofing, etc	$274.50
Building end dock (one-half cost)	86.75
Labor, carpenters, and calkers	413.94
Labor repairing cooking ranges	45.50
Total	820.69
Quarter boat *New Orleans*—Building double deck house:	
Lumber, paints, sash, doors, hardware, etc	2,281.19
Labor, carpenters, and painters	2,834.71
Repairs to hull, labor, carpenters, and calkers	129.75
Total	5,245.65
Barge No. 1—Rebuilding sides, rakes, and deck:	
Lumber, oakum, paint, oil, etc	866.81
Labor, carpenters, and calkers	1,546.17
Total	2,412.98
Barge No. 2—Repairs:	
Oakum and paint	12.80
Labor, calkers, and carpenters	273.33
Total	286.13
Barge No. 3—Rebuilding sides, rakes, and decks:	
Lumber, oakum, cotton, paint, oil, etc	875.79
Labor, carpenters, and calkers	2,110.97
Total	2,986.76
Barge No. 4—Repairs:	
Oakum, paints, oils, etc	11.41
Labor, carpenters, and calkers	154.87
Total	166.28
Barge No. 5—Repairs:	
Oakum, paints, and oil	11.41
Labor, carpenters, and calkers	116.38
Total	127.79
Barge No. 6—Repairs:	
Oakum, paints, and oil	11.41
Labor	13.75
Total	25.16
Barge No. 8—Repairs:	
Oakum and paints	11.41
Labor and calkers	5.25
Total	16.66
Barge No. 9—Repairs:	
Oakum and paint	11.41
Labor and calkers	50.00
Total	61.41
Barge No. 10—Repairs:	
Lumber, oakum, and paint	34.87
Labor, carpenters, and calkers	161.82
Total	196.69

Barge No. 11—Repairs:	
Oakum and paint	$11.41
Labor and calkers	84.50
Total	95.91
Barge No. 12—Repairs:	
Oakum and paint	11.41
Labor, carpenters, and calkers	102.63
Total	114.04
Barge No. 13—Repairs:	
Lumber, oakum, and paint	34.88
Labor, carpenters, and calkers	325.85
Total	360.73
Barge No. 14—Repairs:	
Lumber, oakum, and paint	34.88
Labor, carpenters, and calkers	233.87
Total	268.75
Barge No. 15—Repairs:	
Oakum and paint	11.41
Labor and calkers	111.75
Total	123.16
Barge No. 16 —Repairs:	
Oakum and paints	11.41
Labor and calkers	142.00
Total	153.41
Barge No. 17—Repairs:	
Oakum and paint:	11.40
Labor and calkers	42.65
Total	54.05
Barge No. 18—Repairs:	
Oakum and paint	11.41
Labor and calkers	57.25
Total	68.66
Warehouse No. 2—Repairs:	
Oakum and paint	11.40
Labor and calkers	106.50
Total	117.90
Barge B—Repairs:	
Oakum and paint	11.41
Labor and calkers	96.75
Total	108.16
Skiffs—Repairs and rebuilding:	
Lumber, paint, and other material	5.80
Labor and carpenters	38.13
Total	43.93
Making capstan bars:	
Labor and material	30.25

Repair to wheelbarrows:	
Nails and other material	$6.95
Labor and carpenters	81.25
Total	88.20
General minor repair to plant and tools:	
Labor, blacksmith, and carpenters	199.37
Building platform and approaches to depot:	
Labor	31.25
Building boxes for United States Engineer Office:	
Labor and carpenter	48.12
Dredge *The Ram:*	
Labor and carpenters	91.61

The above amount is for labor and carpenters furnished from the depot. The repairs to *The Ram* have been in charge of the master with monthly employees.

The inside of hull of the quarter boat *New Orleans* has been cleaned and painted with a preparation of pine tar, lard oil, and salt; the hull of Warehouse No. 2 cleaned and whitewashed; eighteen large barges and three small barges cleaned and whitewashed. The total cost of this work was:

Labor	$855.74
Material	52.38
Total	908.12

All steel wire lines have been cleaned and oiled with linseed oil and mineral paint. The cost was $53.59.

At date of this report the entire harbor plant has been laid up at the Government depot, contract has been made for calking the decks of barges, and the work is in progress. Barges Nos. 9, 10, 11, 12, 13, and 14 require extensive repairs to be made serviceable for future work.

Very respectfully, your obedient servant,

WILLIAM GARVIN, *Assistant Engineer.*

Capt. GEO. MCC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 E.

REPORT OF MR. H. S. DOUGLAS, ASSISTANT ENGINEER, IN LOCAL CHARGE OF THE LOWER TENSAS LEVEE DISTRICT.

NATCHEZ, MISS., *May 1, 1895.*

SIR: I have the honor to submit the following report on the construction and repair of levees Lower Tensas levee district for the period from May 1, 1894, to May 1, 1895:

On May 1, 1894, all levee work under contract had been completed except Forest Home (723 R). This levee was completed May 9, 1894. The total length of continuous effective levee line was 129 miles, of which 26.6 miles were below the then established grade, which was 2½ feet above the high water of 1892. A great many of the United States levees were badly rain and wave washed, while others were so thickly grown up with young trees, vines, weeds, and briars as to be impassable.

CONSTRUCTION.

With the allotment for the year 1894–95 the following work was undertaken:

Name of levee.	Below Cairo.	Bank.	Remarks.
	Miles.		
Hard Times-Wilson	631	R.	Enlargement of base.
Hard Times	632	R.	Raising and enlargement.
Kempe, upper section	657	R.	Do.
Kempe, lower section	659	R.	Do.
Deer Park	721	R.	Do.
Forest Home	722	R.	New levee.
Fish Pond Gap	723	R.	Do.
Ahaley	723	R.	New and enlargement.

At Hard Times-Wilson the base was widened and the levee reenforced as described in last report, with the object of preventing leakage through the permeable sand strata underlying the levee. Forest Home was a continuation of the levee of same name built last year, on which work had been stopped from lack of funds. The Fish Pond Gap was a small affair to close an opening that had been left in the levee for drainage. At Ashley a short piece of new levee was necessary on account of caving bank. The balance of the work was routine, raising and enlargement of levees low in grade and weak in section.

The past season has been the most generally favorable for levee work that I have ever known. The river has not been out of the natural banks during the period covered by this report, and there has not been enough rain to flood even the low swamps. Under such circumstances work on the various levees was commenced, prosecuted, and completed without features or incidents calling for special mention.

The work done during the season may be summarized as follows:

Length of new levees built	feet..	8,201.00
Length of old levees enlarged	do...	39,304.00
Total length of levees worked over	do...	47,505.00
Cubic yards placed in new levees		103,785.11
Cubic yards placed in enlargement of old levees		211,239.84
Total cubic yards placed		315,024.95

LOSS OF LEVEES BY CAVING OR ABANDONMENT.

During the year 15,400 running feet of levee, containing 116,000 cubic yards of earth, have been lost by caving banks. The fact that Fish Pond levee of 1893 and the Forest Home levees of 1894–95 form a continuous piece of new levee to replace a long stretch of old work lost by caving banks will serve to explain any apparent discrepancy between the amount of new levee built this year and the amount lost. The present length of effective levee in the Lower Tensas district is now 130 miles, and on this basis the loss from caving during the past season has been a little over 2 per cent.

REPAIRS.

Instead of doing repair work on levees with a hired-labor force from a Government quarter boat, a different plan was adopted during the past season. The district was divided into three subdistricts and an experienced and trustworthy inspector placed in immediate charge of each. Funds were provided and local labor furnishing their own tools were employed. Generally the work was done by what is known as station work; an agreement being made with the laborer or laborers to clean or repair the levee at a stated price per station. A station is 100 linear feet of levee. Occasionally a lump sum was agreed upon for an entire levee. The results of this plan were very satisfactory, and a very much larger amount of work was done for the expenditure than could possibly have been done with a hired-labor force on a quarter boat.

A few of the levees were so grown up as to be impassable either on foot or on horseback, and in consequence it had been impossible to make a careful inspection of them for some time. Over 43 miles of levee was worked over and placed in good condition.

Locality and character of repairs are given in the following table:

Name of levee.	Below Cairo.	Bank.	Length repaired.	Character of repairs.
	Miles.		*Feet.*	
Bedford	606	R.	3,030	Clearing off, scattering weeds and briars.
Hard Times-Wilson	631	R.	45,950	Heavy clearing and grubbing of trees, briars, vines, and weeds.
Hard Times	632	R.	1,050	Light work, clearing off briars and weeds.
Evergreen	636	R.	5,500	Heavy clearing of briars, vines, and weeds.
Hardscrabble	639	R.	23,700	Heavy clearing of weeds and vines.
Bondurant	642	R.	5,350	Light clearing of weeds and vines.
Cottage Home	649	R.	2,461	Light clearing of weeds, filling up rain washes.
Kempe	658	R.	23,575	Light clearing of small trees, weeds, and briars.
Rifle Point	690	R.	16,900	Some heavy clearing; balance light weeds and vines.
Lake Concordia	695	R.	24,423	Clearing off weeds; filling in rain washes.
Arnauldia	702	R.	578	Light work of clearing off weeds.
Morville	710	R.	5,200	Light work, clearing off weeds.
Morville to Greens	715	R.	28,510	Very heavy clearing of weeds, briars, and vines.
Deer Park	721	R.	4,200	Light work, clearing off weeds.
Forest Home	722	R.	7,500	Do.
Fish Pond	723	R.	6,350	Do.
Glasscocks	726	R.	23,731	Very heavy clearing of trees, briars, vines, and weeds.

SURVEYS.

A preliminary survey of Ashwood Levee (623 R) was made, and Hard Times-Wilson (630 R), Hard Times (632 R), Kempe (658 R), and Deer Park (721 R) levees were traversed and cross-sectioned for raising and enlargement. Forest Home (722 R) and Ashley (723 R) were restaked, and a portion of the latter line of levee changed on account of caving bank. Maps, profiles, and estimates of the various levees were prepared by the party in the field. The work may be summarized as follows:

	Miles.
New levees located and surveyed	4.2
Old levee cross-sectioned for enlargement	20.6
Bank line traversed	14.1
Lines of check levels, etc	15.6
Total	54.5

There has been no change of importance in the methods of supervision or of employees engaged on this duty.

The length of effective levee has been slightly increased by the loop line at Forest Home (722 R), and from the head of the district opposite Warrenton, Miss., to the Excelsior plantation (732 R) there is now 130 miles of public levee in the Lower Tensas levee district.

The length of levee built entirely or extensively enlarged by the United States has remained practically at 66.8 miles, the same as last report.

During the year the minimum grade of new levee work has been raised from 2½ feet above high water of 1892 to 3 feet above highest known water at the several localities. The highest known water has been taken to be that of 1890, because while there were floods of greater height in the past, that of 1890 is the only one for which we have reliable local marks. The new grade is generally about 1 foot above the old one. Last report stated that there were 26.6 miles of levee below the then established grade. The work accomplished during the year has resulted in reducing this length to 10.1 miles. From this it will be seen that the levees are now in a better condition than they ever have been since the General Government undertook levee construction.

Very respectfully, your obedient servant,

H. S. DOUGLAS, *Assistant Engineer.*

Capt. GEO. MCC. DERBY,
Corps of Engineers.

APPENDIX 7 F.

REPORT OF MR. H. S. DOUGLAS, ASSISTANT ENGINEER, ON THE SURVEY OF THE HOMOCHITTO LEVEE DISTRICT.

NATCHEZ, MISS., *May 1, 1895.*

SIR: I have the honor to submit the following report on the progress of work in the Homochitto levee district for the period from May 1, 1894, to May 1, 1895:

This district was created by resolution of the Mississippi River Commission of November 19, 1894, approved by the Secretary of War December 1, 1894, transferring 2 per cent of the allotments for each of the other levee districts for the fiscal year ending June 30, 1896, to the new levee district designated as Homochitto.

The Homochitto levee district is on the left bank of the river and extends from Vicksburg to Baton Rouge, a distance of 234 miles by river. It consists of several small basins or areas of land subject to overflow and lying between the river and line of bluffs which the river follows generally between the points stated. From Vicksburg to the State line between Mississippi and Louisiana the district is covered by a local levee board created by the State of Mississippi and known as the "Board of Commissioners for the Vicksburg levee district." From Tunica to Bayou Sara in Louisiana there is a local organization known as the "Board of Commissioners for the Cat Island levee district," created by the State of Louisiana.

The different small basins or subdivisions have been described as follows:

Name.	Begins.		Ends.		Present length by river.
	Below Cairo.	Bank.	Below Cairo.	Bank.	
	Miles.		*Miles.*		*Miles.*
Warrenton to Grand Gulf	609	L.	635	L.	30
Rodney to Coles Creek	652	L.	663	L.	13
Natchez to Ellis Cliffs	703	L.	715	L.	12
Ellis Cliffs to Homochitto	717	L.	745	L.	31
Homochitto to Buffalo	746	L.	754	L.	7
Fort Adams to Tunica	758	L.	770	L.	12
Cat Island levee district	774	L.	799	L.	26

Each one of these small basins has the same general features as the Tensas and Yazoo basins, only on a very minute scale. As in the larger basins, the lower end of each must be left unleveed to allow drainage during low water, and through this opening some of the lands will be subject to overflow from backwater during flood stages of the river. In almost all of these small basins there are isolated systems of private levees that have been more or less efficient in preventing overflow of the lands which they were designed to protect.

As no funds were available for construction, the work done during the past season has consisted entirely of surveys of an unusually extensive character. Such levee work as it is thought the allotment for the forthcoming season will construct has been located and surveyed in the basin from Warrenton to Grand Gulf. All of the basins or subdivisions, except the Cat Island levee district, have been carefully surveyed to determine the areas that would be entirely overflowed by backwater and those that would not; also the areas that would be protected by levees not only against direct overflow, but against backwater of the highest floods. Surveys to determine the character, location, and area of the lands of certain claimants suing the United States in the Court of Claims have been made, and investigations, maps, and reports made.

The small quarter boat *Beta* has been used for the accommodation of the survey party, consisting of a surveyor, rodman, two chain-men, four laborers, cook, and waiter. Considering the size of the party and the character of country traversed, a very large amount of work has been done. The survey of the first basin, from Warrenton to Grand Gulf, was commenced November 14, 1894, and field work on the last, the one from Fort Adams to Tunica, is just completed. The work of the party may be summarized as follows:

	Miles.
Old levee cross-sectioned for enlargement	5.4
New levee line located and surveyed	5.9
Old levee traversed and examined	177.8
Bank lines run	26.4
Meander lines for topography	96.6
Level lines for contours	110
Total	422.1

Over 300 square miles of country have been surveyed. The topographical map showing areas exempt and subject to overflow from water from the basin from Warrenton to Grand Gulf has been completed by the party in the field, and other maps are under way. A line for a levee has been located and surveyed ready for construction as soon as the funds are available. Ample data have been acquired from which to determine the practicability, general location, dimensions, approximate cost, and area that would be protected by levee work that may hereafter be undertaken in this district.

Very respectfully, your obedient servant,

H. S. DOUGLAS, *Assistant Engineer.*

Capt. GEO. MCC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 G.

REPORT OF MR. W. J. HARDEE, ASSISTANT ENGINEER, IN LOCAL CHARGE OF THE ATCHAFALAYA, LAFOURCHE, AND PONTCHARTRAIN LEVEE DISTRICTS.

BATON ROUGE, LA., *May 1, 1895.*

SIR: I have the honor to submit the following report for works under my local direction for the period from May 1, 1894, to May 1, 1895:

GENERAL METHODS.

Surveys.—The method practiced last year has been continued and surveys were made by three small parties, consisting of a surveyor, rodman, and skilled laborer, assisted by such local labor engaged at each levee as was necessary. These parties did not use boats, except as stated below, but moved by public carriers, securing local quarters and board.

During the months of December and January it was found that unapplied balance of allotments existed in the several districts, and it was considered advisable to apply same to levee construction before high water.

To get the proposed lines surveyed and placed under contract in short time, a small survey party was quartered on the U. S. S. *General Newton* and surveyed 19 levees.

The established grade is 2½ feet above the 1893 high water. The actual grade varies from 2 to 3.7 feet above high-water plane, owing to lack of authentic high-water observations at all points throughout the districts.

Tile drainage.—No tile drains were laid during the past year. The tiles laid two years ago have never had sufficient water against the embankment under or behind which they were placed to fully test their practical value.

At the present writing the river has not acquired sufficient height to put the water against the embankments. There has consequently been no further test of the drains than was stated in my report for last year.

Muck or base ditches.—These ditches were cut under levees only at such localities as surrounding conditions suggested the existence of hidden substances likely to impair the integrity of the embankment.

For the purpose of destroying crayfish and muskrat leaks, as well as exposing injurious hidden matter for removal, large base ditches were dug where local conditions required, in front or behind some of the embankments, under the new section, where existing levees were enlarged.

Repairs.—During August, September, and October inspectors were sent in the field and engaged local labor, with which all levees were fully repaired.

There having been no high water last year, the repairs at no levee were extensive nor of special nature, consisting mainly of restoration of rain or wave wash, resodding new embankments, cutting and removal of weeds and other objectionable vegetation, and either creating or restoring impaired drainage of borrow pits.

Supervision.—The method of supervision has been about the same as reported for previous years. It consisted of one regular surveyor, at $125 per month, whose principal duty has been in connection with construction work, although he has been used to make surveys when other duties admitted; one surveyor, at $125 per month, for a portion of the year, who was at first employed making surveys and afterwards on construction work during the busy season; one surveyor, at $100 per month, and one at $90 per month for a part of the year, engaged exclusively on survey of levees.

Such number of inspectors as were required were employed from time to time and paid $90, $75, or $60 per month, according to the amount and responsibility of work intrusted to them.

The duty of an inspector is to remain at all times on his work, keep a daily record of operations, submitting weekly reports of same, and to see that specifications of a contract are faithfully executed.

Inspection.—The usual method of inspection is by rail, boat, or buggy, but from time to time, as they were assigned to duty under me, the United States boats *General Newton* and *General Comstock* were used for purpose of inspection.

ATCHAFALAYA SECTION.

An allotment of $152,000 was made for levee work in this district for the fiscal year ending June 30, 1895. An unexpended balance of $14,139.52 was brought forward from 1894 allotment, aggregating $166,139.52 for expenditure during the year.

Construction.—Contracts were made during the fiscal year 1894 for construction of new levees at Lakeland (799.5 R), St. Louis (856 R), and Old Hickory (873 R), to be paid for from the 1895 allotment.

Lakeland was commenced June 23, 1894, and completed July 21, 1894. Old Hickory was commenced May 16, 1894, and completed July 14, 1894. St. Louis was not commenced until September 12, 1894.

Commencing with September 1, 1894, and subsequently from time to time until February 19, 1895, contracts were made for levee work at the following places, to be paid for from 1895 funds:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Smithland	787	R.	Point Pleasant	862	R.
Nina	806	R.	St. Raphael	862	R.
Hermitage Dike	808	R.	Beatty	863	R.
Anchorage No. 1 and Anchorage No. 2	831	R.	Palo Alto	864	R.
			Dunboyne	865	R.
Cinclare Upper	838	R.	Elmer	866	R.
Cinclare Lower	838	R.	Elmer Lower	866	R.
Cohn	838	R.	Rice	866	R.
Brusley Upper	839	R.	Nodaway	868	R.
Brusley Lower	839	R.	Cora	870	R.
Uhry	841	R.	Belle Grove	871	R.
St. Delphine	841	R.	Dorceyville	868	R.
Eliza	842	R.	Whitecastle	868	R.
Robertson	853.5	R.	Old Hickory No. 2	873	R.
Evergreen	856	R.	Claiborne	875	R.
Olivia	858	R.	Elise	877	R.
Arcadia	859	R.	Modeste	878	R.
Solonque	860	R.	Babin	879	R.
Last Hope	860	R.	Landry	879	R.
Golden Ridge	861	R.	Smoke Bend	884	R.

Lines were surveyed and proposals invited for construction of new levees at Picayuneville (796 R), Poplar Grove Upper (831 R), Poplar Grove Lower (831.5 R), St. Elizabeth (866 R), and Tally Ho (867 R).

At Picayuneville all bids were rejected owing to high prices. At the other named places bids were rejected and the lines not built as a result of objections raised and protests made by property holders.

Extensions of date for completion ranging from four to forty-two days were granted at Nina, Anchorage No. 2, Cohn, Brusley Lower, St. Delphine, Eliza, Arcadia, Golden Ridge, Nodaway, Cora, Claiborne, Elise, Babin, and Landry levees.

At Hermitage Dike (808 R), St. Raphael (862 R), and Whitecastle (868 R) levees, to obviate injury to the embankment and levees, a road crossing was built to afford access to a public landing. At Nina (806 R) two such crossings were built.

Muck or base ditch.—At Smithland (787 R) Levee 1,124 feet of ditch, measuring 4 feet at top, 2 feet at bottom, and 3 feet deep, was dug.

At Cinclare Lower (866 R) Levee 773 feet of ditch, measuring 7 feet at top, 3 feet at bottom, and 5 feet deep, was dug.

At Cora (870 R) Levee 3,680 feet of ditch, measuring 8 feet at top, 3 feet at bottom, and 5 feet deep, was dug.

At Claiborne (875 R) Levee 4,825 feet of ditch, measuring 8 feet at top, 3 feet at bottom, and 5 feet deep, was dug.

The ditch at Smithland was dug through timbered ground, and its mission was to disconnect all roots, etc.

At the other levees the ditch was dug just at the base of the existing embankment, which was being enlarged. The mission of the ditch was to expose for removal all injurious foreign substances, as well as to close up leaks, etc., on the inlet side.

At the 132,072 feet of embankment built and rectified 10,777 feet of base ditch was cut, being about 8 per cent of total length.

Surveys.—During the month of March survey was made and line staked for proposed new levee at New Hope (841.5 R) and Medora Upper (851.5 R).

At the close of this report these works have not been put under contract.

General effectiveness.—Based on the axis of the river as the line of effective measurement, the 132,072 feet of embankment constructed or rectified by enlargement represents 134,445 feet of actual protection.

Repairs.—During the months of August, September, and October all United States levees in this district were fully repaired and put in good condition by hired local labor under the supervision of an inspector. The repairs embraced the removal of worthless wooden revetment, weeds, and objectionable vegetation, restoration of rain and wave wash, and creation or rectification of impaired drainage of borrow pits.

Supervision.—The total cost of supervision has been $10,354.87, from which must be deducted the amount retained on extended contracts, $283.25, making net expenditure of $10,071.62, which is about 6 per cent of total available funds.

Abandonment and condition.—During the year parts of the following levees were abandoned, either by reason of caving banks or construction of extended back lines in anticipation of caving:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Hog Point	787	R.	Belle Grove	870	R.
Fortville Lower	855	R.	Celeste	871.5	R.
Golden Ridge	861.5	R.	Mount Salem	872	R.
Dunboyne	865	R.	Babin	879	R.

The abandoned length aggegates 3,429 feet, embracing, approximately, 43,920 cubic yards.

On May 1, 1895, there are 295,674 feet of good existing levee in this district, built wholly or in part by the United States.

Protection.—At the date of closing this report the river is far below high-water elevation. It has been remarkably low throughout the spring, remaining well within its banks, and no protection work has been necessary.

LAFOURCHE SECTION.

Allotment.—An allotment of $90,000 was made for levee work in this district for fiscal year ending June 30, 1895. An unexpended balance of $10,719.83 was brought forward from the 1894 allotment, making an available total of $100,719.83 for expenditure during the year.

Construction.—At the close of my last annual report no contracts were in force to be paid for from the 1895 funds.

Between October 8, 1894, and December 14, 1894, contracts were awarded for levee work at the following places, to be paid for from 1895 funds:

Name.	Below Cairo.	Bank	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Saulsburg	894	R.	Star	932	R.
Lauderdale	895	R.	Madere	937	R.
Ferchaud	896	R.	Alice Upper	945	R.
Pikes Peak	905	R.	Fortier	946	R.
Laura	911	R.	Soniat	947	R.
Willow Grove	916	R.	Odier	948	R.
Stevenson	918	R.	Willswood	951	R.
Songy	924	R.	Starlight	953	R.

Bids were invited at same time for construction of a levee at Alice Lower (945 R). It was found that since survey had been made the district levee board had executed the work. Bids were consequently rejected.

With few exceptions all contracts were promptly executed Extensions of date for completion, varying from four to fifty-seven days, were made at Ferchaud, Laura, Stevenson, Madere, Fortier, Soniat, Willswood, and Starlight.

Muck or base ditch.—At Willswood (951 R) the old embankment, which was raised and enlarged, was faulty and insecure, owing to many leaks through or under it. To destroy same a ditch, measuring 7 feet at top, 4 feet at bottom, and 4 feet deep, was dug just at the toe of the slope of the old embankment.

At the 42,168¼ feet of levee built and rectified in this district, 3,550 feet of base ditch was dug, being about 9 per cent of the total length of embankment.

Surveys.—During the months of February and March survey was made and lines for proposed work staked at Barton (899 R), Bonsecour (903.5 R), Poor Devil (915 R), Willow Grove (917 R), Fashion (937 R), Nine Mile Point (956 R), and Columbia Garden (957 R).

At the close of this report none of these works have been put under contract.

General effectiveness.—Based on the axis of the river as the line of effective measurement, the 42,168¼ feet of embankment constructed or rectified by enlargement represents 41,250 feet of actual protection.

Repairs.—During the months of August and September all United States levees in this district were put in good condition by hired labor under the direction of an inspector. Repairs were of same character as described for Atchafalaya district.

Supervision.—The total expenditure for supervision has been $6,178.06; amount retained on extended contracts, $235, leaving net expenditure of $5,943.06, which is about 6 per cent of total available funds.

Abandonment and condition.—By reason of construction of new lines, portions of Melancon-Lemanville (893 R) and Flagtown (936 R) levees were abandoned, aggregating 350 feet and embracing, approximately, 3,160 cubic yards.

At the close of the period for which this report is submitted there are 100,582½ feet of good existing levee in this district, built wholly or in part by the United States.

Protection.—Up to May 1, 1895, the river has remained well within its banks. No protection work has therefore been necessary.

PONTCHARTRAIN SECTION.

Allotment.—An allotment of $150,000 was made for levee work in this district for fiscal year ending June 30, 1895, which, with an unexpended balance of $1,716.30 brought forward from the 1894 allotment, made a total of $151,716.30. Later on, $4,633.04, which had been set aside out of the 1893 allotment for the Atchafalaya levee district for construction of a levee machine, was transferred to this district, making a total of $156,394.34 for expenditure during the year.

Construction.—During the fiscal year 1894 contracts were made for construction of new levees at the following places, to be paid from the 1895 allotment:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Laurel Lower	839	L.	Colomb Park	899	L.
Ben Hur Lower	846	L.	Uncle Sam	901	L.
Towles to Billings	851.5	L.	Convent	903	L.
Dennis	854.5	L.	Venus	909	L.
Grenada	858.5	L.	Longue Vue	910.5	L.
Sunshine	860	L.	Sport	915	L.
Virginia	865	L.	Hope Lower	917	L.
Lorlo	867	L.	Belle Point	924	L.
Point Clear	867.5	L.	Good Hope	934.5	L.
Point Clear Lower	869	L.	Rost	940	L.
Arizona	873	L.	Modoc	940.5	L.
Revenue	874	L.	Frellsen	945	L.
Linwood	878	L.			

All of these except Revenue, Convent, Venus, Sport, Hope Lower, Belle Point, Rost, Modoc, and Frellsen were completed before June 30, 1894, and were reported in detail in my last annual report.

At Revenue, Convent, and Belle Point work was well advanced, but operations were suspended from March 26 to May 21, on account of the river leaving its banks and covering the batture from which building material was being obtained.

Venus Levee was commenced on January 26, 1894, and completed August 25, 1894.

Sport Levee was not commenced until December 17, 1894, and finished March 16, 1895. Contractors were not allowed to work until the above date, as the question of location was not until then finally decided.

Hope Lower was commenced July 30, 1894, and completed September 13, 1894. Commencement of work was delayed on account of height of river.

Rost Levee was commenced July 18, 1894, and completed September 24, 1894. Commencement of work was delayed on account of height of river.

Modoc Levee was commenced June 19, 1894, and completed July 25, 1894. Height of river prevented earlier commencement.

Frellson Levee was not commenced until July 6, 1894, and completed August 28, 1894. Final location of levee having been deferred accounts for delay in completion.

Between October 8, 1894, and February 19, 1895, contracts were made for levee work at the following places to be paid for from 1895 funds:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Gourrier	837	L.	Old Church	914	L.
Darrowville	886	L.	Golden Grove	914.5	L.
St. Marys Chapel	894.5	L.	Modoc No. 2	940.5	L.
Jacob	901	L.	Frellsen No. 2	945	L.
Belmont	907	L.	Kenner	947	L.
David	914	L.			

Bids were invited for the construction of a levee at Bagatelle (893 L) and contract made, which was later canceled on account of objection and protest made by a property holder against the construction of the levee.

With few exceptions all works were promptly commenced and completed in advance of contract dates, extensions of time ranging from four to thirty-one days having been granted at Gourrier, David, Golden Grove, and Modoc No. 2 only.

A road crossing was built over the Darrowville Levee (886 L) to furnish the public access to the Donaldsonville-Darrowville Ferry.

Muck or base ditch.—At Golden Grove (914.5 L) levee 4,150 feet of base ditch, measuring 8 feet at top, 3 feet at bottom, and 5 feet deep, was dug at the river toe of slope of existing levee.

At Modoc No. 2 (940.5 L) Levee, 1,535 feet of base ditch, measuring 7 feet wide at top, 3 feet at bottom, and 5 feet deep, was dug at the river toe of the slope of the existing levee.

At both of these places the work consisted of raising and enlarging the existing levee. The embankment was in bad condition. The base ditch was cut to destroy leaks and expose for removal all logs, stumps, etc., within or under the base of the old embankment.

At the 51,861 feet of levee built and rectified 5,685 feet of base ditch was dug, being about 11 per cent of the total length of embankment.

Surveys.—During the months of January, March, and April survey was made and line staked for proposed levee work at the following places:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Shannon	836.5	L.	Thiery	864	L.
Martines	842	L.	Jolly	865	L.
Sharpe	843	L.	David to Poche	914	L.
Hollywood	843.5	L.	Mount Airy	917	L.
Chatsworth	846.5	L.	Glencoe	920	L.
Woodstock	847.5	L.	San Francisco	920	L.
Manchac	847.5	L.			

At the date of closing this report none of these works have been put under contract.

General effectiveness.—Based on the axis of the river as the line for effective measurement, the 51,861 feet of embankment constructed or rectified by enlargement represents 49,295 feet of actual protection.

Repairs.—During the months of August, September, and October, all United States levees in this district were fully repaired and put in good condition by hired local labor under the supervision of an inspector. The repairs were of same character as reported for the preceding districts.

Supervision.—The total cost of supervision has been $5,189.94, from which is to be deducted $90.50, the amount retained for cost of inspection on extended contracts, leaving a net expenditure of $5,099.44, which is about 3¼ per cent of total funds.

Abandonment and condition.—During the year parts of the following levees were abandoned by reason of extending back lines made necessary by caving, or anticipated caving banks: Shannon (836.5 L), Rescue No. 1 (874 L), Uncle Sam (901 L), Hester (908 L), Tessier (909 L) and Hope (916 L).

The length abandoned amounts to 1,641 feet, embracing approximately 28,100 cubic yards.

On May 1, 1895, there are 288,075 feet of good existing levee built wholly or in part by the United States in this district.

Protection.—As late as May 1, 1895, the river has remained well within it banks, in consequence of which no protection work has been necessary.

Very respectfully, your obedient servant,

W. J. HARDEE, *Assistant Engineer.*

Capt. GEO. McC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 H.

REPORT OF MR. JOHN SMYTH, JR., ASSISTANT ENGINEER, IN LOCAL CHARGE OF THE LAKE BORGNE AND BARATARIA LEVEE DISTRICTS.

NEW ORLEANS, LA., *May 1, 1895.*

SIR: I have the honor to submit the following report on the surveys, construction, and repair of levees in the Lake Borgne and Barataria levee districts for the year ending May 1, 1895:

At date of last annual report the only levee unfinished was Carnarvon (978.2 L). For further information see "Construction Lake Borgne district."

LAKE BORGNE DISTRICT.

On May 1, 1894, the total length of United States levees in this district was 8.67 miles, aggregating 372,597.68 cubic yards of earth and 17,479.5 linear feet of revetment.

Percentage of length of existing levee built by United States in this district, 10.2 per cent.

1894-95 LEVEES.

Surveys.—Surveys have been made or revised for the following levees, new and enlargement:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Sugar House	970.6	L.	Fairview Upper	996.4	L.
Violet	975.5	L.	Fairview	997	L.
Merritt	976	L.	Fairview Lower	997.4	L.
Carnarvon Upper	978	L.	Burbridge	998.5	L.
Stella Upper	985.9	L.	Monsecour	999.4	L.
Stella	986	L.	Collette	1,007.6	L.
Linwood	988.7	L.	Davis	1,009.4	L.
Greenwood	990	L.	Louisianna Store	1,009.6	L.
Fanny	993.5	L.	Fort St. Philip	1,039.2	L.
Belair	995	L.			

Construction.—Levees were built at points above named, excepting Belair, upper portion of Fairview Upper, Collette, and Louisiana Store, which were omitted owing to objections of property owners.

The construction of work under allotment of 1894-95 has been accomplished without incident worthy of mention.

Carnarvon (978.2 L) Levee, 1893-94.—During the high-water season weeds had grown on this levee; the clearing of these from embankment was commenced June 28, 1894, embankment construction resumed by contractor's force July 2, 1894, and the work finally completed September 16, 1894, two months and twenty-nine days after commencement.

The total length of levee built and enlarged by the United States in this district during the period covered by this report is 35,908 feet. Total cubic yards of earth placed, 238,453.24. Lost by caving or abandonmont from May 1, 1894, to May 1, 1895, is estimated at 142,000 cubic yards.

Repairs.—This work was done during months of August, September, and October, 1894, by informal contract with citizens in vicinity, under the direction of an inspector employed by this office.

Work accomplished as follows:

Embankment cleared of weeds, etc., 43,217 linear feet	$111.47
Revetment repaired, 219 linear feet	35.02
Wave wash repaired	7.86
Tile drain outlets cleaned	17.50
Borrow pits drained	200.72
Total	372.57

1895-96 LEVEES.

Surveys for proposed new levee work have been made at—

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Brou	970.4	L.	Linwood to Greenwood	988.8	L.
Poydras	977.4	L.	Mary	987.1	L.
Scarsdale	983.9	L.	Belle Vue	1,004.4	L.

Survey party on U. S. quarter boat *Alpha* was sent out April 22, 1895, and continuous survey will be made from the lower line of Jackson Barracks (968.5 L.) to the lower line of Bohemia plantation (1,013.8 L).

Revetment.—Wooden revetment has been constructed at the following levees:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Sugar House	970.6	L.	Belair	995	L.
Linwood	988.7	L.	Monsecour	999.4	L.
Fanny	993.5	L.	Davis	1,009.4	L.

The plan and method of construction same as described in annual report of 1893–94. Total built this season is 4,594.6 linear feet.

During the year about 57,500 cubic yards of earth has been placed by State of Louisiana, consisting principally of enlargement, and a considerable amount of repair work, such as cutting out leaks, restoring wave wash, constructing and repairing wooden revetment has been done by the local levee board.

BARATARIA DISTRICT.

On May 1, 1894, the total length of levee built or enlarged by United States in this district, 10.62 miles, aggregating 356,692.91 cubic yards of earth and 22,929.5 linear feet of revetment. Percentage of length of existing levee built by United States, 12.8 per cent.

1894–95 LEVEES.

Surveys.—Surveys have been made or revised for the following levees, new and enlargement:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Getzinger	960	R.	Live Oak Extension	992	R.
Belle	960.6	R.	Star Upper	994.5	R.
Browns	961.7	R.	La Reussite	996.4	R.
Kearney Upper	982.2	R.	La Rose	1,003.4	R.
Kearney Lower	983.1	R.	Purcelle	1,003.8	R.
Concession	985.3	R.	Hermitage	1,005.7	R.
Concord Upper	986	R.	Woodland	1,009.7	R.
Concord Lower	987	R.	West Pointe a la Hache	1,010.6	R.
Cedar Grove	989	R.	Riceland	1,015.6	R.
Sarah	991	R.			

Construction.—Levees were constructed at points above named excepting lower portion of Concord Upper, Star Upper, Purcelle, and West Pointe a la Hache, which were omitted, owing to the objections of property owners.

The construction work under allotment of 1894–95 has been accomplished without incident worthy of mention.

The total length of levee built and enlarged by the United States in this district during the period covered by this report is 29,063 feet. Total cubic yards of earth placed, 234,400.57.

Lost by caving or abandonment from May 1, 1894, to May 1, 1895, is estimated at 157,300 cubic yards.

Repairs.—This work was done at the same time and by the same method as in Lake Borgne district.

Work accomplished as follows:

Embankment cleared of weeds, etc., 55,051 linear feet	$269.67
Revetment repaired	19.74
Wave wash repaired	18.91
Tile drain outlets cleaned	6.27
Borrow pits drained	107.84
Total	422.43

1895–96 LEVEES.

Surveys for proposed new levee work have been made at—

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Company Canal	958.2	R.	Turcan	996.1	R.
Concession Extension	985.5	R.	Alliance	998	R.
Star Upper	994.5	R.	Wood Park	1,002.9	R.

Continuous survey of effective levee is contemplated as soon as that in the Lake Borgne levee district shall have been completed.

Revetment.—Wooden revetment has been constructed at the following levees:

Name.	Below Cairo.	Bank.	Name.	Below Cairo.	Bank.
	Miles.			*Miles.*	
Belle	960.6	R.	La Reussite	996.4	R.
Browns	961.7	R.	La Rose	1,003.4	R.
Kearney Lower	983.1	R.	Purcelle	1,003.8	R.
Concession	985.3	R.	Hermitage	1,005.7	R.
Sarah	991	R.	Woodland	1,009.7	R.
Live Oak Extension	992	R.	West Point a la Hache	1,010.6	R.
Star Upper	994.5	R.			

The plan and method of construction same as described in annual report of 1893–94. Total length built this season is 15,925.2 feet.

During the year about 19,200 cubic yards of earth has been placed by the State of Louisiana, principally new levee, and a considerable amount of repair work such as cutting out leaks, restoring wave wash, constructing and repairing wooden revetment has been done by the local levee boards.

Protection.—The low stage of the river with no indications of flood this season has rendered protection or preparation for such unnecessary.

Personnel.—One surveyor employed at $100 per month whose duties consist of making surveys for new levee work and executing all instrument work at levees under construction and when completed. Inspectors were employed at the several levees and paid $60, $75, and $90 per month, according to size and number of works under their direction, such being governed by their efficiency. Duties of inspectors consisted in seeing that specifications and detail instructions were strictly adhered to, keeping a record of work, and submitting weekly reports of operations.

Very respectfully, your obedient servant,

J. SMYTH, JR., *Assistant Engineer.*

Capt. GEO. MCC. DERBY,
Corps of Engineers, U. S. A.

APPENDIX 7 I.

PRIVATE LEVEES, FOURTH DISTRICT, MISSISSIPPI RIVER.

Table of private protection levees.

LOWER TENSAS LEVEE DISTRICT.

Name of plantation.	Length of levee.	Average height.	Section.		
			Crown.	Front slope.	Back slope.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Holly Grove and Du Rossett	28,600	3	3	2 to 1	2 to 1
Do	2,600	5	3	2 1	2 1
Do	8,000	3	3	2 1	2 1
Balmoral	8,000	3	3	2 1	2 1
Balmoral, Franklin, Blackwater, Verona, Rutherford, and Kenilworth	47,000	2.5	2	2 1	2 1
Front of Winter Quarters	9,450	5	3.5	2 1	2 1
Front of Evergreen	11,300	4	3	2 1	2 1
Belleview and Lakeland	26,400	4	3	2 1	2 1
Panola and Osceola	30,000	3	2	2 1	2 1
Panola	13,000	3	3	2 1	2 1
Mount Arrarat, Avondale, Mound Place, Oneata, Osceola, and Locust Ridge	50,000	3	2	1½ 1	1½ 1
Mound Place	13,000	4	3	2 1	2 1
Cross Keys	22,000	3	3	2 1	2 1
Oneata, Maryland, Delta, St. Peter, and Dixie	87,000	3	3	2 1	2 1
Shady Grove, Window Hall, St. Marys, Waverton, and Helena	80,000	5	4	2½ 1	2½ 1
Consuelo and Ravenwood	34,000	4	4.5	3 1	3 1
Spoken, Innisfail, and Pittsfield	36,300	3.5	4	2 1	2 1
Roseland	11,800	7	6	2 1	2 1
Point Pleasant, Excelsior, and Home Place	47,000	4	3	1½ 1	1½ 1

Table of private protection levees—Continued.

LOWER TENSAS LEVEE DISTRICT—Continued.

Name of plantation.	Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
Holly Grove and Du Rossett	30,000	Unknown.	Since 1867	Unknown.
Do	16,000	Unknown.	Prior to 1870	Do.
Do	8,000	Unknown.	do	Do.
Balmoral	8,000	Unknown.	do	Do.
Balmoral, Franklin, Blackwater, Verona, Rutherford, and Kenilworth.	30,000	Unknown.	do	Do.
Front of Winter Quarters	25,000	Unknown.	Since 1874	Scrapers and cast with shovels.
Front of Evergreen	20,000	Unknown.	1882 or prior	Unknown.
Belleview and Lakeland	43,000	Unknown.	1862–1868	Wheelbarrows or cast by shovels.
Panola and Osceola	30,000	Unknown.	1862	Cast with shovels.
Panola	13,000	Unknown.	1862–1868	Do.
Mount Arrarat, Avondale, Mound Place, Oneata, Osceola, and Locust Ridge.	36,000	Unknown.	Prior to 1890	Scrapers.
Mound Place	21,000	Unknown.	1874	Scrapers and barrows.
Cross Keys	22,000	Unknown.	1862	
Oneata, Maryland, Delta, St. Peter, and Dixie.	87,000	Unknown.	1862–1868, 1893	Casting scrapers and barrows.
Shady Grove, Window Hall, St. Marys, Waverton, and Helena.	200,000	Unknown.		Wheelbarrows and scrapers.
Consuelo and Ravenwood	110,000	$30,000		Unknown; possibly wheelbarrows.
Spoken, Innisfail, and Pittsfield	44,400	Unknown.		Do.
Roseland	70,000	Unknown.	Unknown	Scrapers.
Point Pleasant, Excelsior, and Home Place	77,000	Unknown.	Prior to 1890	Do.

Name of plantation.	Purpose of protecting.	Effectiveness.	Remarks.
Holly Grove and Du Rossett.		Withstood backwater of 1893.	
Do		do	Known as "Burn Levee."
Do		1 to 2 feet above backwater of 1893.	Known as "Wyoming Levee."
Balmoral		do	
Balmoral, Franklin, Blackwater, Verona, Rutherford, and Kenilworth.		Broke several places 1882, 1883, and 1884.	Since 1884 its effectiveness has not been tested.
Front of Winter Quarters		Effective against 1882, 1883, and 1884.	Best maintained private levee in the district.
Front of Evergreen		Effective against any recent overflow.	Joins upper end of United States "Evergreen Levee."
Belleview and Lakeland	Island inside Lake Bruin.	Flood of 1882 went 1½ feet above levee.	
Panola and Osceola			Levee in bad condition.
Panola		Overtopped by flood of 1882.	Built to grade of backwater of 1867.
Mount Arrarat, Avondale, Mound Place, Oneata, Osceola, and Locust Ridge.		Has not been tested	Supposed grade 1 foot above backwater of 1882.
Mound Place		Thorough, except in 1882	
Cross Keys		Stood 1893, but topped by 1882.	
Oneata, Maryland, Delta, St. Peter, and Dixie.	Encircles plantations.	Topped by 1882, but stood 1890 and 1893.	Grade 1.5 feet above 1890 overflow.
Shady Grove, Window Hall, St. Marys, Waverton, and Helena.		Broke 1882	A draining machine was contemplated in original plan.
Consuelo and Ravenwood	Plantations named.	2 feet below flood 1882, otherwise thorough.	Cost includes draining machine, which is still used.
Spoken, Innisfail, and Pittsfield.	do		
Roseland		Thorough	Grade is elevation of 1893 water in river.
Point Pleasant, Excelsior, and Home Place.		Broke 1890; now effective.	Grade is 0.5 foot above 1892 water.

Table of private protection levees—Continued.

ATCHAFALAYA LEVEE DISTRICT.

Name of plantation.	Name of owner.	Below Cairo.	Length of levee.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Cinclare	Harry L. Laws	838	3,000	12,200	7
Stonewall	L. Kirkland	839	896	1,050	5
St. Delphine	August Levert	841	2,700	5,400	8
Australia	E. M. and V. M. Lefebvre	847.5	6,000	.....	4.5
Union	Edward J. Gay Planting and Manufacturing Co.	853	4,000	15,000	5
St. Louis	....do	855.5	7,500	2,400	7
Lower Eimer	B. Lotz	866	4,400	10,000	7
St. Elizabeth	A. G. Lorio	866.5	.....	7,000	4
Glenmore	George M. Murrell Planting and Manufacturing Co.	867	.....	4,800	4
Blythewood	M. L. Randolph	867	2,700	5,400	4
Augusta	George M. Murrell Planting and Manufacturing Co.	867	.....	14,000	7
Forest Home	Berthencourt and Contelles	867	13,500	13,500	6
Catharine	Mrs. J. Supple	868	4,800	6,000	3.5
Annandale	Ibberville Planting and Manufacturing Co.	869.5	5,021	3,636	4.5
Chatham	J. A. Berthelot	875	1,500	.....	3
Germania	G. B. Reuse	876	3,600	2,400	5
Elise	....do	877	2,400	.....	4
McManor	McCall and Legendre	882	7,500	.....	3
Evan Hall	McCall Bros. Planting and Manufacturing Co.	883	12,000	20,400	4

Name of plantation.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Cinclare	4	2½ to 1	3 to 1	92,609	$13,000	May and July, 1879.	Wheelbarrows.
Stonewall	2	1½ 1	1½ 1	3,009	300	1880	Do.
St. Delphine	4	1½ 1	1½ 1	38,400	Unknown.	1891-1893	Wheelbarrows and drag scrapers.
Australia	6	1½ 1	1½ 1	19,500	Unknown.	1868	Do.
Union	4	2½ 1	3 1	40,500	6,075	1882 to 1890	Do.
St. Louis	3	3 1	3 1	61,600	9,240	1883	Do.
Lower Eimer	3	1½ 1	1½ 1	44,000	Unknown.	Unknown	Unknown.
St. Elizabeth	3	1½ 1	1½ 1	9,300	Unknown.	1890	Drag scrapers.
Glenmore	1.5	1½ 1	1½ 1	5,300	Unknown.	Unknown	Unknown.
Blythewood	2	1½ 1	1½ 1	9,600	1,440	1867	Barrows and cast with shovels.
Augusta	3	1½ 1	1½ 1	49,000	Unknown.	1876	Wheelbarrows.
Forest Home	2	1½ 1	1½ 1	66,000	9,900	1876	Wheelbarrows and cast by shovels.
Catharine	1	3 1	3 1	16,000	1,760	1880	Drag scrapers.
Annandale	5	2½ 1	3 1	27,799	6,115	1884	Wheelbarrows.
Chatham	1.5	1½ 1	1½ 1	1,000	160	1894	Cast with shovels.
Germania	4	2 1	2 1	15,500	2,000	1888	Wheelbarrows.
Elise	2	1½ 1	1½ 1	2,500	Unknown.	1883	Cast with shovels.
McManor	3	1½ 1	1½ 1	6,200	680	Jan. and Feb., 1893.	Do.
Evan Hall	3.5	1½ 1	1½ 1	45,600	10,000	1887	Wheelbarrows.

Table of private protection levees—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

Name of plantation.	Purpose of protecting from crevasse water.	Effectiveness.	Remarks.
Cinclare	600 A	Broke 1884; water stood 2 feet over top 1890.	
Stonewall	60 A	Thorough	1890, water from Lobdell and Morganza stood 3 inches from top; much seepage.
St. Delphine	800 A		Grade 3 feet lower than water of Hickey crevasse (1868).
Australia	300 A	Water of Hickey ran over portion.	
Union	1,000 A	Thorough	1890, water stood within 2 feet of top; slight seepage.
St. Louis	2,000 A	.....do	1890, water stood 5 feet against levee; slight seepage.
Lower Eimer	350 A	1882, water 2 feet above top; held 1884.	
St. Elizabeth	300 A	Thorough	Grade, one-half foot above crevasse water, 1882; 1890, 2 feet against; little seepage.
Glenmore	100 A	1882, 3 feet above top; 1874, 1884, 1890, top.	Free seepage.
Blythewood	300 A	1882, 2½ feet over top; 1890, 1½ feet below.	Levee is 2 miles from Mississippi River.
Augusta	600 A	1882, 3 feet above top; 1884, 1890, 1 foot below.	Levee is 3 miles from Mississippi River.
Forest Home	700 A	1882, water stood 3 feet above top.	Levee is 4 miles from Mississippi River.
Chatharine	480 A	1882, water 1½ feet above top	
Annandale	600 A	Thorough	Grade, one-half foot above crevasse water of 1882.
Chatham			Levee not yet completed; will be 3,400 feet in length.
Germania	400 A	Thorough	Grade is to height of crevasse water of 1882.
Elise	200 A	Ascension crevasse ran over top	
McManor	180 A		Grade 3 feet below crevasse water of 1882.
Evan Hall	700 A		Grade 1 foot above crevasse water of 1882.

PONTCHARTRAIN LEVEE DISTRICT.

Name of plantation.	Name of owner.	Below Cairo.	Length of levee.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Ben Hur	A. Adler & Co	846	.....	2,000	3.5
Chateworth	F. Gardere	846.5	7,500	.....	4
Longwood	E. M. Lefebre & Co	847	7,700	13,000	6
Woodstock	Mrs. E. C. Walker	847.5	3,000	.....	5
Grenada	Ventress & Co	856.5	10,000	.....	2.5
Point Clear	R. Milliken	867.5	3,000	.....	3
Cottage Farm	J. C. Green	877.5	.....	5,200	2.5
Linwood	J. C. Brown	878	2,000	1,400	3
Belle Helene	Belle Helene Planting Co	879	14,000	.....	3.5
Riverton-Donaldson	Miles Planting and Manufacturing Co.	890	2,400	12,000	7
Clarke, Conway, and Orange Grove.	.....do	891	27,900	.....	5
Monroe	.....do	892	.....	13,000	9
Rapidan	E. Bourgeois & Bro	899	4,000	.....	3
Helvetia	E. Cherbonnier	899.5	.....	2,300	5
Wilton	E. N. Pugh	900	4,600	4,000	6
St. Rose	W. H. Vredenburgh	900.5	3,400	5,000	5
Lilly	Duhon & Manuel	901	1,200	5,000	4
Uncle Sam	J. & C. Jacobs	901.5	10,800	24,000	8.5
Hester	Jesse Ross	908.5	8,600	10,480	6
St. Elmo	F. Damare	910	1,500	15,000	3.5
Davis	Estate of D. P. McCann	914.5	1,600	.....	4
Golden Grove	August Servel	915	3,800	.....	3
Sport	F. Waugnespack	915.5	3,200	2,900	7
Mount Airy	Joseph Le Bourgeois	916.5	6,300	.....	3
Hope	R. Milliken	917	.....	9,000	5
San Francisco and Union	Mrs. S. H. Bourgere	920	5,240	19,400	7
Terre Haute	Mrs. Catharine T. Cofield	921.5	8,600	5,400	7
Star	Leon Godchaux	922	2,900	5,700	8
Reserve	.....do	922.5	4,335	4,500	8

Table of private protection levees—Continued.

PONTCHARTRAIN LEVEE DISTRICT—Continued.

Name of plantation.	Name of owner.	Below Cairo.	Length of levee.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Cornland	Morris Edrington	923.5	4,000	4,000	5.5
Belle Point and Labranche	Leon Godchaux	925	4,000	22,400	9
New Era	Lucien Montague	925.5	4,200	1,200	6
La Place	Mrs. B. La Blanc	926	12,000	16,300	6
Woodland	Wm. Chaffe Co., Limited	927	2,000	2,000	3
Diamond	Joseph Weill & Bros	934	9,000	.....	5
Ormond	Charles E. Alter	938.5	6,200	.....	4
Destrahan	Emile Rost	940	4,800	10,000	5
Patterson	Champagne, Hymel & Torregrossa	944	8,900	10,500	5
Fairview	H. G. Morgan	945	8,000	7,000	6
St. George	Mrs. C. St. Martin	954.5	3,000	.....	3
Union	Oury Bros. and others	921	2,880	.....	8

Name of plantation.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Ben Hur	1.5	1½ to 1	1½ to 1	2,000	$100	Jan. 1892	Cast with shovels.
Chatsworth	2.5	1½ 1	1½ 1	9,500	Unknown.	1858	Wheelbarrows.
Longwood	3	2 1	2 1	69,000	5,520	1894	Wheelbarrows and drag scrapers.
Woodstock	4	1½ 1	1½ 1	7,500	Unknown.	Prior to 1864.	Unknown.
Grenada	1.5	1½ 1	1½ 1	4,700	Unknown.	1857	Cast with shovels.
Point Clear	2	2 1	2 1	2,700	225	1890	Do.
Cottage Farm	3	1½ 1	1½ 1	3,300	400	June, July, 1893.	Wheelbarrows and cast with shovels.
Linwood	3	2 1	2 1	3,400	Unknown.	1857	Unknown.
Belle Helene	2	2 1	2 1	15,500	2,350	1892, 1893, and 1894.	Wheelbarrows and drag scrapers.
Riverton-Donaldson.	4	1½ 1	1½ 1	49,800	12,450	Mar., April, 1893.	Wheelbarrows.
Clarke, Conway, and Orange Grove.	1	1½ 1	1½ 1	39,200	9,800	Unknown	Do.
Monroe	4	1½ 1	1½ 1	76,500	13,000	1890, 1892, and 1893.	Do.
Rapidan	1	1½ 1	1½ 1	2,500	300	March, 1890.	Drag scrapers, wheelbarrows, and cast with shovels.
Helvetia	4	1½ 1	1½ 1	4,500	Unknown.	June, 1892	Drag scrapers.
Wilton	2	1½ 1	1½ 1	21,000	2,000	Feb., Mar., 1894.	Drag scrapers, wheelbarrows, and cast with shovels.
St. Rose	3	1½ 1	1½ 1	16,000	2,000	Jan., Mar., Apr., 1893.	Drag scrapers.
Lilly	2	1½ 1	1½ 1	7,400	Unknown.	1882	Wheelbarrows.
Uncle Sam	2	1½ 1	1½ 1	61,000	Unknown.	1858, 1891, 1892, 1893.	Wheelbarrows and drag scrapers.
Hester	4	2 1	2 1	57,000	6,000	1882	Wheelbarrows.
St. Elmo	1.5	1½ 1	1½ 1	14,500	Unknown.	Prior to 1864.	Unknown.
Davis	2	1½ 1	1½ 1	1,900	600	June, 1893	Wheelbarrows.
Golden Grove	1.5	1½ 1	1½ 1	2,500	Unknown.	March, 1890.	Cast with shovels.
Sport	3	2 1	2 1	27,000	3,500	1893	Drag scrapers.
Mount Airy	2	1½ 1	1½ 1	4,500	Unknown.	1894	Cast with shovels.
Hope	3	1½ 1	1½ 1	17,500	Unknown.	1891	Wheelbarrows.
San Francisco and Union.	4	1½ 1	1½ 1	92,500	9,250	1890–1894	Drag scrapers.
Terre Haute	4	1½ 1	1½ 1	40,500	4,700	Jan., April, 1894.	Wheelbarrows.
Star	4	1½ 1	1½ 1	46,000	12,000	1891	Do.
Reserve	6	1½ 1	2 1	52,000	10,000	1891	Do.
Cornland	3	1½ 1	1½ 1	18,000	5,000	1890	Do.
Belle Point and Labranche.	6	2 1	2 1	173,000	34,600	May, 1893–Feb., 1894.	Wheelbarrows and drag scrapers.
New Era	3	1½ 1	1½ 1	14,500	Unknown.	Unknown	Unknown.
La Place	3	1½ 1	1½ 1	94,000	Unknown.	1890–1893	Drag scrapers.
Woodland	2	2 1	2 1	3,500	Unknown.	1891	Do.
Diamond	3	1½ 1	1½ 1	17,500	2,360	During 1893, 1894.	Wheelbarrows.
Ormond	2	1½ 1	1½ 1	6,500	Unknown.	Unknown	Unknown.
Destrahan	6	2 1	2 1	44,000	Unknown.	do	Do.
Patterson	7	2½ 1	2½ 1	52,000	Unknown.	1884	Wheelbarrows.
Fairview	4	1½ 1	1½ 1	38,000	Unknown.	Unknown	Unknown.
St. George	4	1½ 1	1½ 1	2,800	Unknown.	1892	Drag scrapers.
Union	4	1½ 1	1½ 1	13,500	2,000	March, 1893.	Wheelbarrows.

Table of private protection levees—Continued.

PONTCHARTRAIN LEVEE DISTRICT—Continued.

Name of plantation.	Purpose of protecting from crevasse water.	Effectiveness.	Remarks.
Ben Hur	* 100 A	Thorough	Highest water stood 1 foot against levee.
Chatsworth	150 A	Rescue crevasse ran over portion.	
Longwood	(†)		Levee is now building and will be 24,000 feet in length.
Woodstock	500 A	Rescue crevasse ran over top.	
Grenada	‡ 700 A	Thorough	In rainy seasons water stands ½ foot against levee; seepage free.
Point Clear	§ 495 A	do	Water seldom stands against levee; no seepage.
Cottage Farm	100 A	do	Rescue water stood within few inches of top; very little seepage.
Linwood	450 A	Rescue water ran over; held Landry.	
Belle Helene	1,800 A	Rescue crevasse water ran over top.	Levee incomplete when water ran over; grade now 1 foot above Rescue.
Riverton-Donaldsen.	1,300 A	Thorough	Rescue water stood 5 feet against levee; very little seepage.
Clarke, Conway, and Orange Grove.	4,052 A	do	Rescue and Belmont water stood few inches of top; free seepage.
Monroe	1,800 A	do	Belmont water stood 5 feet against levee; little seepage.
Rapidan	100 A	Nita ran over; Belmont 4 inches from top.	
Helvetia	250 A	Thorough	Belmont water stood 4 feet against levee; free seepage.
Wilton	480 A		
St. Rose	340 A		
Lilly	70 A	Belmont 6 inches above top.	Very little seepage.
Uncle Sam	250 A	Belmont ran over top	Rescue water stood 4 feet against levee; seepage very free.
Hester	700 A	Belmont 5 inches over top	
St. Elmo	250 A	Belmont and Nita water stood over top.	Rescue water stood 2 feet against levee; little seepage.
Davis	150 A	Thorough	Rescue water stood within few inches of top; very free seepage.
Golden Grove	200 A	Belmont and Nita water stood over top.	Rescue water stood 1 foot against levee; free seepage.
Sport	200 A	Thorough	Cypress piling 2 inches thick extends for entire length of levee.
Mount Airy	350 A	Nita-Belmont over top	
Hope	600 A	Thorough	Belmont water reached within few inches of top; very little seepage.
San Francisco and Union.	700 A	do	Belmont water reached within few inches of top of levee.
Terre Haute	600 A		
Star	330 A	Thorough	Belmont water stood 4½ feet against levee; very little seepage.
Reserve	720 A	do	Belmont water stood 4 feet against levee; very little seepage.
Cornland	200 A	Nita 2½ over top; Belmont top.	
Belle Point and Labranche.	1,200 A		Net grade 2 feet above water from Nita crevasse.
New Era	150 A	Nita water broke levee; Belmont top.	Free seepage.
La Place	800 A	Thorough	Belmont crevasse water stood 6 inches against levee.
Woodland	Few A	do	
Diamond	1,200 A		Grade 1 foot above highest water in swamps back of plantation.
Ormond	450 A	Sarpy water stood 3 feet above top.	
Destrahan	600 A	Bonnet Carre few inches of top.	Slight seepage.
Patterson	250 A	Sarpy water stood 4 inches above top.	
Fairview	1,000 A		
St. George	100 A	Thorough	Grade 1 foot above water from Sarpy, Anchor, and Belmont crevasses.
Union	400 A	do	Levee built on several small tracts of land.

* From bayou water. † Plantation from crevasse. ‡ From swamp water. § From rice-field water.

Table of private protection levees—Continued.

LAFOURCHE LEVEE DISTRICT.

Name of plantation.	Name of owner.	Below Cairo.	Length of levee.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Point Houmas	Cofield & Rollins	891	1,400	.....	4.5
Pikes Peak	J. D. Caskins & Co	905	4,000	.....	4
Felicity	Folse & Bertrand	908	1,600	.....	3
St. James	Miles Planting and Manufacturing Co.	909.5	5,200	.....	3
Armant	.....do	910	10,000	11,000	3
Laura	A. F. Waguespack	911	1,200	2,400	3.5
Home Place	Florestan Waguespack	913	1,200	.....	3
Succeed	A. F. Waguespack	913.5	1,260	.....	4
Evergreen	A. Songy	917	8,000	.....	4
Carroll	Estate of Bradish Johnson	918	13,000	3,000	5
Columbia	Caire, Graugnard & Co	923	4,900	8,000	5
California and Gold Mine	Mrs. F. E. Tassin	924	4,900	5,000	3
Glendale	George Sarpy	927	.....	2,700	5
Amelia	Joseph R. Hymel	928	3,200	9,000	4
Trinity	H. A. LeSassier	929	2,400	10,000	8
Waterford and Killona	R. Milliken	931	9,600	4,500	6
Star	Mrs. E. Bourbon	931.5	3,554	4,335	5
Speranza	LeBrache Planting Co., Limited	938.5	4,800	5,400	5
Ashton	Ashton Planting Co., Limited	939	6,700	20,000	4
Ellington	Ellington Planting Co	940	3,500	23,000	4.5
Willswood	Schmidt & Zeigler	951	.....	2,000	9
Fairfield	R. Milliken	954	.....	4,500	7
Southside	A. O. & F. M. Ames	959	5,250	28,560	5
Fazende	L. H. Marrero	960	2,000	5,000	4

Name of plantation.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Point Houmas	3	1½ to 1	1½ to 1	3,700	Unknown.	Jan., Feb., Mar., 1894.	Cast with shovels.
Pikes Peak	2	1½ 1	1½ 1	4,700	Unknown.	1884.....	Unknown.
Felicity	1	1½ 1	1½ 1	850	Unknown.	1884.....	Cast with shovels.
St. James	2	1½ 1	1½ 1	6,400	Unknown.	1884.....	Do.
Armant	2	1½ 1	1½ 1	24,500	Unknown.	1884.....	Do.
Laura	1.5	1½ 1	1½ 1	2,700	Unknown.	1890.....	Cast with shovels and drag scrapers.
Home Place	2.5	1½ 1	1½ 1	900	Unknown.	1891.....	Drag scrapers.
Succeed	2.5	1½ 1	1½ 1	1,600	Unknown.	1891.....	Do.
Evergreen	2	1½ 1	1½ 1	9,500	Unknown.	1891.....	Do.
Carroll	4	1½ 1	1½ 1	33,000	Unknown.	1891.....	Drag scrapers and wheelbarrows.
Columbia	6	2 1	2 1	31,000	Unknown.	Unknown...	Unknown.
California and Gold Mine.	3	1½ 1	1½ 1	8,250	Unknown	.....do	Do.
Glendale	3	1½ 1	1½ 1	5,250	Unknown.	1886.....	Wheelbarrows and drag scrapers.
Amelia	3	2 1	2 1	17,400	Unknown.	1891.....	Drag scrapers.
Trinity	12	2½ 1	2½ 1	125,000	$8,500	1891.....	Wheelbarrows and drag scrapers.
Waterford and Killona.	4	1½ 1	1½ 1	40,700	7,500	1891.....	Do.
Star	4	2 1	2 1	20,400	3,060	1891.....	Do.
Speranza	4	2½ 1	3 1	33,500	Unknown.	1891.....	Do.
Ashton	2.5	1½ 1	1½ 1	33,600	Unknown.	1885–1892....	Do.
Ellington	1	1½ 1	1½ 1	36,400	Unknown.	Unknown...	Unknown.
Willswood	4	3 1	3 1	30,600	1,100	May–June, 1894.	Dredge boat.
Fairfield	4	1½ 1	1½ 1	15,000	1,875	1891.....	Wheelbarrows.
					15,568	Jan.–June, 1893.	Wheelbarrows and dredge boat.
Southside	4	2½ 1	3 1	111,200			
Fazende	3	3 1	3 1	15,500	1,500	1884.....	Wheelbarrows.

Table of private protection levees—Continued.

LAFOURCHE LEVEE DISTRICT—Continued.

Name of plantation.	Purpose of protecting from crevasse water.	Effectiveness.	Remarks.
Point Houmas	(*)	Thorough	
Pikes Peak	200 A	1884 water ran over top.	
Felicity	40 A	do	
St. James	300 A	Thorough	Ames crevasse, water reached top of levee; great deal of seepage.
Armant	600 A	do	Ames crevasse, water came within few inches of top; free seepage.
Laura	125 A	do	Do.
Home Place	175 A	do	Ames crevasse, water reached top; free seepage.
Succeed	180 A	do	Ames crevasse, water came within few inches of top; slight seepage.
Evergreen	400 A	do	Ames crevasse, water came within few inches of top; free seepage.
Carroll	920 A	do	Ames crevasse, water came within ½ foot of top; free seepage.
Columbia	800 A	do	Davis crevasse, water stood 2½ feet, and Ames, 1 foot against; no seepage.
California and Gold Mine.	450 A	do	Ames crevasse, water stood 2 feet against; free seepage.
Glendale	(†)	do	
Amelia	800 A	do	Water from Ames crevasse stood 1 foot below top; free seepage.
Trinity	500 A		Grade 1 foot above water from Ames crevasse.
Waterford and Killona.	1,000 A	Thorough	Ames crevasse, water stood 1 foot below top; very little seepage.
Star	120 A		Grade ½ foot above Davis crevasse water.
Speranza	200 A		Grade 1½ feet above Ames crevasse water.
Ashton	1,000 A		Grade ½ foot above Ames crevasse water.
Ellington	900 A		Ames crevasse water reached top; great deal of seepage.
Willswood	2,000 A		Levee not completed; grade ½ foot above highest crevasse water.
Fairfield	935 A		Grade 2 feet lower than Ames crevasse water.
Southside	1,600 A		Grade ½ foot above Ames crevasse water.
Fasende	300 A	Davis, water 1½ feet over; Ames, 2 feet above.	

* Field from drainage water. † To arrest drainage.

Table of protection levees.

PARISH OF ORLEANS, BARATARIA LEVEE DISTRICT.

Name of section.	Name of owner.	Below Cairo.	Length of levee.	Average height.
		Miles.	*Feet.*	*Feet.*
Gretna Upper	Town of Gretna	962	6,600	10
Gretna Lower and Gouldsboro.	Towns of Gretna and Gouldsboro	963	9,240	2
McDonoghville and Algiers	Towns of McDonoghville and Algiers	964.5	7,000	6

Name of section.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Gretna Upper	8	3 to 1	3 to 1	90,000	$5,000	1890	Scrapers and wheelbarrows.
Gretna Lower and Gouldsboro	3	2 1		19,000	9,500	1891	Cast with shovels.
McDonoghville and Algiers.	4	1½ 1		12,600	6,300	1891	Wheelbarrows and shovels.

Table of protection levees—Continued.

PARISH OF ORLEANS, BARATARIA LEVEE DISTRICT—Continued.

Name of section.	Purpose of protecting—	Effectiveness.	Remarks.
Gretna Upper	Town from possible crevasse water.	Levee broke 1891.	Levee 1 mile from river; back line joins railroad embankment.
Gretna Lower and Gouldsboro.	do	Thorough	Earth for construction brought in on cars; levee 1 mile back.
McDonoghville and Algiers.	do	do	Levee ¾ mile from river; constructed by Orleans Levee Board.

Table of levees protecting the city of New Orleans, Orleans Parish.

LAKE BORGNE LEVEE DISTRICT.

Name of section.	Name of owner.	Below Cairo.	Length of levee.	Average height.
		Miles.	*Feet.*	*Feet.*
Upper Protection Levee	City of New Orleans	962-65	2,640	5.5
Do	do	962-65	25,500	7
Do	do	962-65	5,300	3.8
Lake Pontchartrain Levee	do	962-65	2,120	8.3
Lake Shore Levee	do	962-65	4,800	7.7
Orleans Tail Race Levee	do	962-65	35,920	5.3
Lake Protection Levee	do	962-65	Unknown.	5.4
Bayou St. John Levee	do	962-65	27,000	7
London Avenue Levee	do	962-65	21,000	7.6
Lower Protection Levee	do	962-65	16,000	12.3
Lake Shore Levee	do	962-65	11,000	8
Florida Walk Levee	do	962-65	15,000	8
Interior Protection Levee	do	962-65	Unknown.	Unknown.

Name of section.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Upper Protection Levee.	8	3 to 1	3 to 1	13,200	$6,600	1890	Unknown.
Do	40	2 1	2 1	382,500	382,500	1871-1876	Do.
Do	8	3 1	3 1	14,500	7,476	1892	Do.
Lake Pontchartrain Levee.				82,680	82,680	1871-1876	Do.
Lake Shore Levee	8	3 1	3 1	4,800	12,360	1894	Wheelbarrows.
Orleans Tail Race Levee.	40	2 1	2 1	319,600	291,880	1871-1876	Unknown.
Lake Protection Levee.	20	1½ 1	1½ 1	Unknown.	Unknown.	1875	Do.
Bayou St. John Levee.	6	2½ 1	2½ 1	130,000	38,350	Being built	Dredge.
London Avenue Levee.				130,000	Unknown	do	Shovels, cast up.
Lower Protection Levee.	14	1½ 1	1½ 1	240,000	240,000	1871-1876	Unknown.
Lake Shore Levee	8	3 1	3 1	100,000	26,700	Being built	Do.
Florida Walk Levee	10	3 1	3 1	160,000	Unknown.	do	Dredge.
Interior Protection Levee.				Unknown.	Unknown.	Unknown	Unknown.

Table of levees protecting the city of New Orleans, Orleans Parish—Continued.

LAKE BORGNE LEVEE DISTRICT—Continued.

Name of section.	Purpose of protecting city from—	Effectiveness.	Remarks.
Upper Protection Levee.	Storm water and crevasses.	Thorough.	
Do	....do	....do	
Do	....do	....do	This is a supplemental levee on top of Upper Protection Levee.
Lake Pontchartrain Levee.	....do	....do	
Lake Shore Levee	....do	....do	About 1,500 feet from lake shore; constructed of excavation from canal.
Orleans Tail Race Levee.	....do	....do	
Lake Protection Levee.	....do	....do	This levee is the embankment of the Spanish Fort Railroad.
Bayou St. John Levee.	....do	....do	Earth is being dredged from Bayou St. John; will be completed in January.
London Avenue Levee.	....do	....do	
Lower Protection Levee.	....do	....do	Used as embankment for New Orleans and Northeastern Railroad; earth from People's Canal.
Lake Shore Levee	....do	....do	About 1,200 feet from lake; will require revetment.
Florida Walk Levee	....do	....do	Is being built by New Orleans and Northeastern Railroad to be used as railroad bed.
Interior Protection Levee.	....do	....do	On top of Metairie and Gentilly ridges; small fill and section.

Table of private protection levees.

BARATARIA LEVEE DISTRICT.

Name of plantation.	Name of owner.	Below Cairo.	Length of line.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Southside	O. A. & F. M. Ames	958	16,700	31,300	4.5
Amesville	L. H. Marrero	959.5	2,100	5,200	4
Amesville to Gretna	Several owners	960	13,000	.....	4
Aurora	.....	970	4,500	.....	3
Orleans	.....	971	6,000	.....	3
Stanton	Milliken & Rutledge	973	8,700	6,000	6
Beka	Brugeirres, Levert & Co	976.5	5,400	9,600	4
Magnolia	C. A. Larendon	979	6,000	4,000	3
Fort St. Leon	A. Brusland	981	4,400	2,400	4
Belle Chasse	J. P. Kearney	983	14,760	9,000	5
Concession and Concord	Hardie & Co	985.5	10,380	8,100	8
Oak Point	Hero & Cousins	987	3,500	4,000	3
Cedar Grove	James Wilkinson and H. Mahoney	989.5	1,600	32,000	3.5
Sarah	C. C. Packard	990.6	3,200	10,800	2.5
Live Oak Grove	C. P. Wilkinson	991.5	6,000	4,000	3
Star	Euclid Borland	994	3,765	835	4
La Reussite (settlement)	Several owners	996.5	13,660	1,900	4
Alliance, St. Rosalie, and Myrtle Grove.	T. S. Wilkinson and others	1001	32,200	.....	8
Deer Range	St. Agnes Orphan Asylum, Maryland.	1,005	18,400	11,000	4
Junior	L. F. Jacks	1,006	5,600	7,000	4
Point Celeste	Estate of Bradish Johnson	1,007	8,400	14,000	4.5
Do	....do	1,007	8,400	.....	4.5
Woodland	....do	1,009	12,970	7,000	4
Vevay	T. H. Ballowe	1,010.6	675	840	3.5
Magnolia	H. C. Warmoth	1,012	7,840	8,000	6

Table of private protection levees—Continued.

BARATARIA LEVEE DISTRICT—Continued.

Name of plantation.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Southside	4	2 to 1	2 to 1	100,000	Unknown.	1884, 1892–93	Dredge and wheelbarrows.
Amesville	3	2 1	2 1	11,900	$1,500	1884	Wheelbarrows.
Amesville to Gretna.	4	2 1	2 1	23,100	Unknown.	Unknown	Wheelbarrows and shovels.
Aurora	2	1½ 1	1½ 1		Unknown.	Prior to 1860.	Do.
Orleans	2	1½ 1	1½ 1		Unknown.	do	Do.
Stanton	3.5	2 1	2 1	50,600	12,140	1891	Do.
Beka	3	1½ 1	1½ 1	21,400	Unknown.	1884	Do.
Magnolia	2	1½ 1	1½ 1	7,200	Unknown.	1858	Cast with shovels.
Fort St. Leon	2	1½ 1	1½ 1	8,000	2,000	1884	Shovels and wheelbarrows.
Belle Chasse	3	2 1	2 1	57,200	Unknown.	1858	Do.
Concession and Concord.	5	2 1	3 1	139,500	15.247	1887	Dredged.
Oak Point	2	1½ 1	1½ 1	5,420	Unknown.	Prior to 1860.	Cast with shovels.
Cedar Grove	2	1½ 1	1½ 1	4,500	Unknown.	1891	Wheelbarrows and shovels.
Sarah	2	1½ 1	1½ 1	7,500	Unknown.	Prior to 1860.	Unknown.
Live Oak Grove.	2	1½ 1	1½ 1	7,200	1,800	1891	Wheelbarrows and shovels.
Star	2.5	1½ 1	1½ 1		300	1892	Shovels.
La Reussite (settlement).	3	1½ 1	1½ 1	20,700	5,500	1882	Do.
Alliance, St. Rosalie, and Myrtle Grove.	8	4½ 1	4½ 1			1894	Dredge.
Deer Range	3	1½ 1	1½ 1	43,500	8,000	1884	Wheelbarrows and shovels.
Junior	3	2 1	2 1	20,500	Unknown.	Prior to 1860.	Do.
Point Celeste	8	4 1	4 1	97,500	Unknown.	Prior to 1858.	Dredge and wheelbarrows.
Do	4	2 1	2 1		Unknown.	1884	Shovels, etc.
Woodland	6	4 1	4 1		Unknown.	1858	Dredge and wheelbarrows.
Vevay	4	1½ 1	1½ 1	1,620	Unknown.	1889–1891	Cast with shovels.
Magnolia	12	2½ 1	2½ 1	95,000	Unknown.	Unknown	Wheelbarrows, shovels, and dredge.

Name of plantation.	Purpose of protecting against—	Effectiveness.	Remarks.
Southside	Crevasse water	Highest water 6 feet against levee.	15,600 feet from Mississippi River.
Amesville	do	Broke during Davis crevasse.	5,200 feet from Mississippi River.
Amesville to Gretna	do	Did not protect Davis and Ames.	6,000 feet from Mississippi River.
Aurora	do	Inundated from Bell crevasse, 1858.	4,000 feet from Mississippi River.
Orleans	do	do	Do.
Stanton	do	Broke	4,800 feet from Mississippi River.
Beka	do	Thorough	3,000 feet from Mississippi River.
Magnolia	do	Water from Bell ran over	4,000 feet from Mississippi River.
Fort St. Leon	do	Thorough	
Belle Chasse	do	Water from Davis and Ames ran over.	1,600 feet from Mississippi River.
Concession and Concord	do	Water from Ames ran over	3,100 feet from Mississippi River.
Oak Point	do	Water from Davis and Ames 5 feet over top.	3,000 feet from Mississippi River.
Cedar Grove	do	Water from Ames 1½ feet over top.	1,600 feet from Mississippi River.
Sarah	do	Water from Davis and Ames 4 feet over top.	7,000 feet from Mississippi River.
Live Oak Grove	do	Water from Ames ran over	2,000 feet from Mississippi River.
Star	do	Highest water 3 feet against.	850 feet from Mississippi River.
La Reussite (settlement)	do	Water from Davis and Ames ran over top.	1,900 feet from Mississippi River.
Alliance, St. Rosalie, and Myrtle Grove.	do	Not tested	3,500 feet from Mississippi River.
Deer Range	do	Thorough	5,500 feet from Mississippi River.

Table of private protection levees—Continued.

BARATARIA LEVEE DISTRICT—Continued.

Name of plantation.	Purpose of protecting against—	Effectiveness.	Remarks.
Junior	Crevasse water	Water from Davis ran over	3,500 feet from Mississippi River.
Point Celeste	do	Water from Davis 3 feet over top.	7,000 feet from Mississippi River.
Do	do	Thorough	3,000 feet from Mississippi River.
Woodland	do	do	5,000 feet from Mississippi River.
Vevay	do	do	
Magnolia	do	do	4,000 feet from Mississippi River.

LAKE BORGNE LEVEE DISTRICT.

Name of plantation.	Name of owner.	Below Cairo.	Length of levee.		Average height.
			Back line.	Side line.	
		Miles.	*Feet.*	*Feet.*	*Feet.*
Corinne	A. L. Richardson	972	3,600	5,700	2
Saxenholm	B. S. Story	974	8,000	8,000	2
Repose	E. & M. Lehman	976	4,200	4,000	1.5
Poydras	Hill & Gillis	977	7,920	.....	2
Caernarvon	Fred Meyer	978	4,825	.....	2
Orange Grove	M. Frank	979.5	.....	.....	2
St. Clair	George Garr	982	6,000	.....	3.5
Mon Plaisir	H. P. Kernochan	983	4,400	.....	2
Scarsdale	do	984	8,600	.....	4
Stella	S. Harner	986	9,400	8,000	3
Mary	S. Mathe	987.5	3,400	.....	3
Promised Land	B. C. McCann heirs	988.5	9,400	.....	4
Linwood	Elias Lathrap	989.5	3,300	.....	3
Greenwood	Irving S. Lathrap	990	2,400	2,200	3
Fanny	Citizens Bank of New Orleans, La	993	9,120	6,000	4
Belair	Belair Planting Co	995	22,000	15,000	4
Fairview	do	996	.....	.....	.....
Monticello	C. V. Thibaut and others	997	2,600	2,500	3
Burbridge	S. Haspel	998.5	5,200	5,200	4
Monsecour	John Kelly	999.4	10,200	2,200	4
Harlem	S. Haspel	1,002.5	4,600	6,000	3.5
Belleview	Estate of Bradish Johnson	1,004.5	6,000	7,400	3.5
Bohemia	N. M. Hebert	1,014	8,492	.....	4

Name of plantation.	Section.			Approximate cubic yards.	Approximate cost.	Date of construction.	Method of construction.
	Crown.	Front slope.	Back slope.				
	Feet.	*Feet.*	*Feet.*				
Corinne	3	1½ to 1	1½ to 1	4,200	$150	1874	Cast with shovels.
Saxenholm	1	1½ 1	1½ 1	4,800	400	1879	Do.
Repose	3	2 1	2 1	3,000	300	1860	Do.
Poydras	4	1½ 1	1½ 1	4,100	Unknown.	1862	Do.
Caernarvon	4	1½ 1	1½ 1	2,500	575	Unknown	Do.
Orange Grove	4	1½ 1	1½ 1	3,600	825	do	Do.
St. Clair	6	2 1	2 1	7,400	Unknown.	1853 or 1854	Do.
Mon Plaisir	2	1½ 1	1½ 1	1,629	Unknown.	Prior to 1862	Do.
Scarsdale	6	2 1	2 1	17,800	Unknown.	Prior to 1874	Wheelbarrows.
Stella	2.5	2 1	2 1	15,120	Unknown.	1874	Do.
Mary	8	2 1	2 1	5,200	Unknown.		Shovels.
Promised Land	3.5	2 1	2 1	16,400	4,920	1890–91	
Linwood	3	2 1	2 1	3,300	Unknown.		Do.
Greenwood	3	2 1	2 1	6,100	Unknown.	Prior to 1882	Probably shovels.
Fanny	6	2 1	2 1	31,400	Unknown.	Prior to 1860	Do.
Belair	4	2 1	2 1	67,900	Unknown.	1874 or prior	Wheelbarrows and dredge.
Monticello	2	1½ 1	1½ 1	3,700	925	1891	Shovels.
Burbridge	4	2 1	2 1	18,000	2,000	Prior to 1870	Wheelbarrows and shovels.
Monsecour	4	1½ 1	1½ 1	18,400	Unknown.	Prior to 1876	Do.
Harlem	4	2 1	2 1	15,200	Unknown.	Prior to 1871	Shovels.
Belleview	3	2 1	2 1	17,400	Unknown.	do	Do.
Bohemia	6	2 1	2 1	17,600	Unknown.	Prior to 1857	Do.

Table of private protection levees—Continued.

LAKE BORGNE LEVEE DISTRICT—Continued.

Name of plantation.	Purpose of protecting—	Effectiveness.	Remarks.
Corinne	High tides of lake	Lake Storm water 8 inches over levee.	5,700 feet from Mississippi River.
Saxenholm	do	Lake Storm water 1½ inches over levee.	4,000 feet from Mississippi River.
Repose	do	do	Do.
Poydras	do	1 foot water against in low places.	Distance from river 2,500 feet one end and 7,000 feet other end.
Caernarvon	do	do	2,500 feet from Mississippi River.
Orange Grove	do	do	2,400 feet from Mississippi River.
St, Clair	Feared crevasse English Turn.	do	2,300 feet from Mississippi River.
Mon Plaisir	Swamp water and high tides.	2 feet highest known against levee.	Joins St. Clair and Scarsdale levees; 3,000 feet from Mississippi River.
Scarsdale	Swamp water and possible crevasse.	Highest water 4 feet, 1874	Held out water from Greenwood crevasse, 1874.
Stella	From crevasse	Highest water 5 feet	Do.
Mary	Swamp water and high tides.	Water from Greenwood ran over.	6,000 feet from Mississippi River; joins Stella and Promised Land levees.
Promised Land	do	Highest water against levee, 3 feet.	Levee is built through a swamp.
Linwood	Swamp water	Thorough	3,500 feet from Mississippi River.
Greenwood	High tides and crevasses	Highest water against 3 feet.	2,500 feet from river.
Fanny	do	Overflowed by Greenwood crevasse.	3,000 feet from river.
Belair	High tides and crevasse.	Highest water 4 feet; thorough.	4,500 feet from river.
Monticello	Tide water	Highest water 3 feet; swamp water.	3,500 feet from Mississippi River.
Burbridge	do	Highest water 4 feet; thorough.	2,600 feet from river.
Monsecour	do	Highest water 4 feet; tide water.	800 feet from Mississippi River.
Harlem	do	Highest water 3.5 feet; St. Sophie crevasse.	3,000 feet from Mississippi River.
Belleview	do	do	Do.
Bohemia	do	Highest water to top; tide water.	2,500 feet from Mississippi Rvier.

APPENDIX 7 J.

REPORT OF CAPT. GEORGE M'C. DERBY, CORPS OF ENGINEERS, UPON USE OF THE DREDGE RAM IN LEVEE BUILDING.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., June 4, 1895.

COLONEL: The condition of the channel at the mouth of Red River is such that it is probable that the dredge *Ram* will not be required at that locality for more than a very few months during the present season.

As this dredge was built to pump 300 cubic yards of sand per hour and deliver it a distance of 300 feet from the side of the dredge and 10 feet above the water, and as her ordinary operating expenses do not exceed $44 per day, it appeared to me that it ought to be practicable to deliver this material on shore and construct a levee with it for very much less than the actual cost of doing the work with the wheel scraper by contract. This should be the case particularly in the Lake Borgne and Barataria districts, where the levees are rarely more than 8 feet high nor more than 100 feet from the edge of the bank, and where the level of the bank is so low that wheel scrapers do not work to advantage on account of the bogging of the mules. The average cost of the work done in these districts last year was 13.7 cents per cubic yard as against 12.4 cents for the whole of the fourth district.

If, then, the material can be dredged and delivered on the line of the levee for about 2 cents per cubic yard, the difference between this and 13.7 cents ought to afford an ample margin for controlling the flow of water, separating it from the solid material, and causing the latter to deposit in the shape of a levee, provided it is practicable to do it at all.

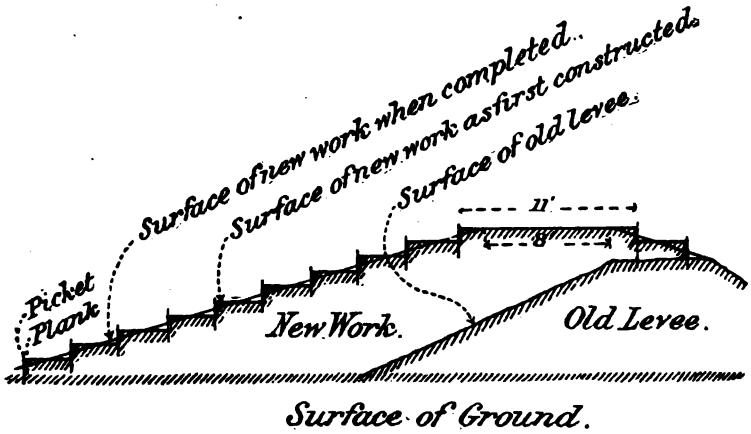
Under this belief I recently put the *Ram* to work enlarging the levee on Nine Mile Point, opposite Carrollton, an old levee, 8.5 feet high and of weak section, which required raising and strengthening by enlarging on the river side.

The dredge was on the work twelve days, when she had to stop to go to Red River. The difficulties encountered, though only such as were anticipated, proved much more difficult to cope with, with only rough-and-ready appliances, than was expected; so that the practical results obtained were limited to building a short length of levee to the full height of the old levee and raising a line about 1,400 feet long an average height of about 2 feet. This work was, however, sufficient to demonstrate the practicability of the system and to develop the essential details of a working method, so that with the knowledge we now have the dredge can be put to work and kept at work without constant interruption, due to washouts on the line of the levee.

Four methods of confining the flow and separating the solid material were tried.

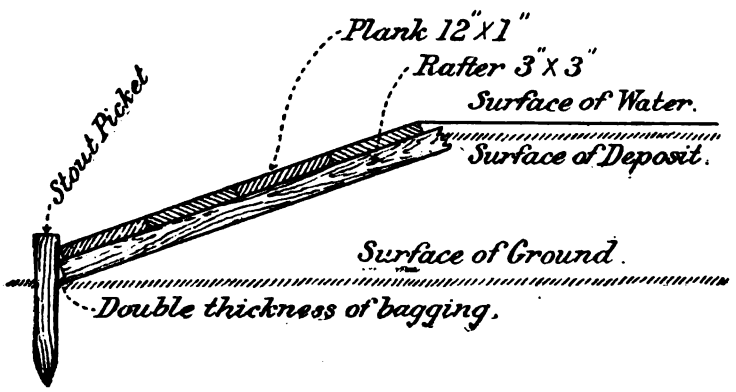
(1) Raising a small levee of earth, about 1 foot high, along the foot of the slope of the new work, parallel to the old levee; pumping into the space between this small levee and the old one; using the material pumped to raise the small levee inch by inch; allowing the water to flow off longitudinally, escaping at the farther end of the work, about 1,300 feet away.

(2) Substituting for the small levee above described a line of plank on edge, held in place by a line of pickets driven into the ground, then placing successive lines of planks secured in like manner, at such height and interval as to raise the levee in small terraces as shown on the sketch below.



The water to escape longitudinally, or when necessary laterally, over the top of each terrace.

(3) Placing a line of light timbers at intervals of 10 feet on the proposed slope, like rafters of a roof; laying the plank on these rafters so as to raise the slope gradually, plank by plank, keeping the edge of the topmost plank only an inch or two above the level of the solid material deposited inside; securing the foot of the slope by means of a flap of bagging tacked to the edge of the bottom plank and buried in the ground, the surplus water to escape laterally by flowing over the edge of the top plank.



(4) Substituting light frames covered with bagging for the plank above mentioned, allowing the surplus water to escape laterally by percolation through the bagging.

The above four methods are mentioned in the order of their simplicity and economy.

The first failed entirely on account of the impracticability of handling the freshly deposited material fast enough, to raise the small levee to keep pace with the work of the pump.

The material (ordinary batture sand) when first deposited is in the nature of a very sticky quicksand, which it is almost impossible to handle with either shovel or hoe.

As soon as the small levee was overtopped anywhere along the line a crevasse occurred, which rapidly enlarged and drained out all the confined water, washing away much or the work accomplished. These crevasses were difficult and expensive to repair.

The second method succeeded as soon as experience had shown how many inches the bottom of each terrace plank should be made to overlap the top of the preceding one. The minimum lap was found to be 4 inches, and I think in practice 6 inches would be better.

A sufficient length of the levee was raised to a height of 8.5 feet to develop the fact that the difficulty of the work does not increase materially as the levee gains in height. The topmost terraces were constructed with the same ease as the lower ones, once the proper method was understood.

The third method was tested sufficiently to prove its practicability, but it is materially more expensive than the second method and is not worth developing, since the cheaper method is satisfactory.

The practicability of the fourth method remains in doubt, and it is still more expensive than the third.

In my projects for the expenditure of the funds for 1896, I have recommended that, in suitable cases, levee work be done with the ram when she is not required in Old River. I think this method of construction is worth developing, as it may lead to important reductions in the cost of levee work, as the following figures would suggest:

Crew of Ram.	Per month.	Crew of Ram.	Per month.
1 master	$140.00	3 deck hands, at $30	$90.00
1 engineer	90.00	1 cabin boy	20.00
1 engineer	85.00		
1 engineer	60.00	Total	660.00
1 fireman	45.00	Subsistence 12 men, at 40 cents	144.00
1 cook	45.00	Oil and waste	6.00
1 watchman	45.00		
1 deck hand	40.00	Total for wages, subsistence, etc.	810.00

Assuming twenty-five working days to the month, the daily expense on *The Ram* would be $32.40 plus $12 per diem for coal.

The expense on shore would be:

6 deck hands, at $30	$180.00
Subsistence, at $12	72.00
Total per month	252.00
Total per working day	10.08

For the construction of a levee 1,000 feet long and 10 feet high, containing 13,000 cubic yards of material, about 10,000 feet of lumber, at $12 per 1,000 feet, would be necessary, which would cost $120, say 1 cent per cubic yard, but as nearly all of this lumber would be used again and again, it would be safe to estimate its cost at 0.25 cent per cubic yard.

No measurements have ever been made that will give positive information as to the number of cubic yards of material *The Ram* will handle day in and day out. On her contract test she pumped 300 cubic yards per hour. It would seem as if she might be counted upon to do 2,000 cubic yards per day of ten hours.

At this rate of progress the expense account would stand as follows:

	Per cubic yard.
Labor, subsistence, etc., on *Ram*, $44.40	$0.0222
Labor, subsistence on land, $10.08	.0050
Lumber	.0025
Total	.0297

or, say, 3 cents per cubic yard.

It is probable that contingencies of one kind and another will run this price up 5 or 6 cents, at first at any rate; but there still remains a wide margin between this and the contract price of 13.7 cents.

It is further to be borne in mind that the wages of the master of *The Ram*, and part of the crew, must run on whether she is at work or idle, and there would therefore be economy in finding some useful work for her to do when not required in Old River.

Very respectfully, your obedient servant,

GEO. MCC. DERBY,
Captain of Engineers.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.,
President Mississippi River Commission.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 17, 1894.

Abstract of proposals received in response to advertisement dated September 4, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of a levee on Cowpen Neck, near Natchez, Miss.

[Proposals marked * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance. Bid No. 1 is for all or none.]

No.	Name and address of bidder.	Section A.		Section B.	
		Embankment and excavations, 58,000 cubic yards.	Total cost of section.	Embankment and excavations, 58,000 cubic yards.	Total cost of section.
		Cents.		*Cents.*	
1	John Scott & Sons, St. Louis, Mo.	11.40	$6,612.00	11.40	$6,612.00
2	Lamb & Carry, Memphis, Tenn.	11½	6,525.00	11½	6,815.00
3	Edwin B. Helgason, Natchez, Miss.	10	5,800.00	.....	.....
4	Hayes Bros., Baton Rouge, La.	17	9,860.00	17	9,860.00
5	C. D. Leeper & Co., Baton Rouge, La.	13½	7,830.00	15.74	9,129.20
6	J. A. Andrews & Son, Baton Rouge, La.	13¾	7,975.00	13¾	7,975.00
7	Eltringham Construction Co., Natchez, Miss.	*10	5,800.00	*11	6,380.00
8	A. P. Martin, Waterproof, La.	14	8,120.00	14½	8,265.00
9	Manning & Gibson, Oakwood, Miss.	15	8,700.00	14.	8,120.00
10	Albert H. Gillespie, Vidalia, La.	13.90	8,062.00	.....	.....
11	D. B. Hearin & Co., Baton Rouge, La.	13.20	7,656.00	.....	.....
12	C. A. Winter, Greenville, Miss.	12½	7,250.00	16	9,280.00
13	Chas. H. Dameron & Co., Friars Point, Miss.	13½	7,830.00	18	10,440.00
14	Junius R. Ward, Jr., Longwood, Miss.	11.99	6,954.20	.....	.....

No.	Name and address of bidder.	Section C.		Section D.	
		Embankment and excavations, 58,000 cubic yards.	Total cost of levee.	Embankment and excavations, 58,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	John Scott & Sons, St. Louis, Mo.	11.40	$6,612.00	11.40	$6,612.00
2	Lamb & Carry, Memphis, Tenn.	* 11½	6,670.00	15¾	9,135.00
3	Edwin B. Helgason, Natchez, Miss.	.....	.....	* 11½	6,670.00
4	Hayes Bros., Baton Rouge, La.	17	9,860.00	25	14,500.00
5	C. D. Leeper & Co., Baton Rouge, La.	14½	8,410.00	13.97	8,102.60
6	J. A. Andrews & Son, Baton Rouge, La.	13¾	7,975.00	17.04	10,092.00
7	Eltringham Construction Co., Natchez, Miss.	16.45	9,541.00	17.45	10,121.00
8	A. P. Martin, Waterproof, La.	15	8,700.00	14	8,120.00
9	Manning & Gibson, Oakwood, Miss.	13.97	8,102.60	12.97	7,522.60
12	C. A. Winter, Greenville, Miss.	15½	8,990.00	16¾	9,715.00
13	Chas. H. Dameron & Co., Friars Point, Miss.	15	8,700.00	16½	9,570.00

Amount available	$157,190.11
Amount covered by this abstract	25,520.00
Balance	131,670.11

UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 24, 1894.

No. 9 (1895).—*Abstract of proposals received in response to advertisement dated September 13, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

LOWER TENSAS LEVEE DISTRICT.

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance.]

No.	Name and address of bidder.	Hard Times, enlargement.		Deer Park, enlargement.	
		Embankment and excavations, 35,000 cubic yards.	Total cost of levee.	Embankment and excavations, 15,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	Eltringham Construction Co., Natchez, Miss.	.....	.....	18	$2,700.00
2	Edwin B. Helgason, Natchez, Miss	.....	.....	12½	1,875.00
3	Sullivan & Gray, Baton Rouge, La.....	33	$11,550.00	17	2,550.00
4	J. A. Carson, Baton Rouge, La.....	22	7,700.00	15	2,250.00
5	Garbish & O'Neil, Memphis, Tenn.....	*19.90	6,965.00	14.40	2,160.00
6	Albert H. Gillespie, Vidalia, La	.....	.....	*12.40	1,860.00
7	John Scott & Sons, St. Louis, Mo.....	24.9	8,715.00	17	2,550.00
8	James R. Marlow, Natchez, Miss	.....	.....	.....	.....
9	A. P. Martin, Waterproof, La.....	29	10,150.00	16	2,400.00
10	Manning & Gibson, Oakwood, Miss	.....	.....	15	2,250.00

No.	Name and address of bidder.	Forest Home.		Ashley, new and enlargement.	
		Embankment and excavations, 90,000 cubic yards.	Total cost of levee.	Embankment and excavations, 32,500 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	Eltringham Construction Co., Natchez, Miss.	.....	.....	15.40	$5,005.00
2	Edwin B. Helgason, Natchez, Miss	.....	.....	9	2,925.00
3	Sullivan & Gray, Baton Rouge, La.....	14	$12,600.00	14¼	4,712.50
4	J. A. Carson, Baton Rouge, La.....	15	13,500.00	12.99	4,221.75
5	Garbish & O'Neil, Memphis, Tenn.....	13.70	12,330.00	11.45	3,721.25
6	Albert H. Gillespie, Vidalia, La	.....	.....	*7.93	2,577.25
7	John Scott & Sons, St. Louis, Mo.....	*11.7	10,530.00	11.9	3,867.50
8	James R. Marlow, Natchez, Miss	.....	.....	11¾	3,818.75
9	A. P. Martin, Waterproof, La.....	15½	13,950.00	13	4,225.00
10	Manning & Gibson, Oakwood, Miss.....	15	13,500.00	14	4,550.00

Amount available	$82,000.00
Amount covered by this abstract.....	21,932.25
Balance.....	60,067.75

UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 25, 1894.

No. 10 (1895).—*Abstract of proposals received in response to advertisement dated September 13, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

ATCHAFALAYA LEVEE DISTRICT.

[Proposals marked thus * are the lowest received, and the bidders considered responsible, they are recommended for acceptance.]

No.	Name and address of bidder.	Evergreen, enlargement.		Olivia, enlargement.	
		Embankment and excavations, 8,000 cubic yards.	Total cost of levee.	Embankment and excavations, 37,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
2	Donovan & Daley, Baton Rouge, La	19½	$1,560.00	13.40	$4,958.00
3	J. A. Carson, Baton Rouge, La	17	1,360.00	13	4,810.00
4	John Scott & Sons, St. Louis, Mo	19.9	1,592.00	11.93	4,414.10
5	C. D. Leeper & Co., Baton Rouge, La	24	1,920.00	16	5,920.00
6	Sullivan & Gray, Baton Rouge, La	16.92	1,353.60	12.73	4,710.10
7	Israel R. Bobbitt, Baton Rouge, La			14.96	5,535.20
8	R. M. Quigley & Co., St. Louis, Mo	14.93	1,194.40	13.74	5,083.80
10	Hayes Bros., Baton Rouge, La	*11	880.00	11	4,070.00
11	P. J. Millett, Baton Rouge, La	15	1,200.00	*11	4,070.00

No.	Name and address of bidder.	Arcadia, enlargement.		Last Hope.	
		Embankment and excavations, 22,000 cubic yards.	Total cost of levee.	Embankment and excavations, 13,200 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	John Treinen, Donaldsonville, La			11.25	$1,485.00
2	Donovan & Daley, Baton Rouge, La	10.70	$3,354.00	10.70	1,412.40
3	J. A. Carson, Baton Rouge, La	17	3,740.00	12	1,584.00
4	John Scott & Sons, St. Louis, Mo	10.73	2,360.60	13	1,716.00
5	C. D. Leeper & Co., Baton Rouge, La			14	1,848.00
6	Sullivan & Gray, Baton Rouge, La	13	2,860.00	*9.43	1,244.70
7	Israel R. Bobbitt, Baton Rouge, La	13.20	2,904.00	11⅜	1,501.50
8	R. M. Quigley & Co., St. Louis, Mo	11.93	2,624.60	11.93	1,574.76
9	Geo. Byrnes & Co., Baton Rouge, La	11½	2,530.00	11½	1,485.00
10	Hayes Bros., Baton Rouge, La	*10½	2,310.00	10	1,320.00
11	P. J. Millett, Baton Rouge, La	11	2,420.00	12½	1,650.00
12	D. B. Hearin & Co., Baton Rouge, La			12	1,584.00

No.	Name and address of bidder.	Soulouque, enlargement.		Beatty.	
		Embankment and excavations, 10,000 cubic yards.	Total cost of levee.	Embankment and excavations, 13,500 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	John Treinen, Donaldsonville, La	11.95	$1,195.00	10.94	$1,476.90
2	Donovan & Daley, Baton Rouge, La	*10.70	1,070.00	12.40	1,674.00
3	J. A. Carson, Baton Rouge, La	17	1,700.00	11	1,485.00
4	John Scott & Sons, St. Louis, Mo	13.4	1,340.00	10.7	1,444.50
5	C. D. Leeper & Co., Baton Rouge, La	14	1,400.00	13	1,755.00
6	Sullivan & Gray, Baton Rouge, La	11	1,100.00	*9.43	1,273.05
7	Israel R. Bobbitt, Baton Rouge, La	14	1,400.00	11⅜	1,535.62
8	R. M. Quigley & Co., St. Louis, Mo	11.93	1,193.00	10.93	1,475.55
10	Hayes Bros., Baton Rouge, La	12	1,200.00	9.90	1,336.50
11	P. J. Millett, Baton Rouge, La	14	1,400.00	12	1,620.00
12	D. B. Hearin & Co., Baton Rouge, La			11.20	1,512.00

No. 10 (1895).—*Abstract of proposals received in response to advertisement dated September 13, 1894, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Palo Alto, enlargement.		Dunboyne, enlargement.	
		Embankment and excavations, 25,000 cubic yards.	Total cost of levee.	Embankment and excavations, 3,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
2	Donovan & Daley, Baton Rouge, La	*12.40	$3,100.00	14.40	$432.00
3	J. A. Carson, Baton Rouge, La	15	3,750.00	16	480.00
4	John Scott & Sons, St. Louis, Mo	12.9	3,225.00	17	510.00
5	C. D. Leeper & Co., Baton Rouge, La	13	3,250.00	*13	390.00
6	Sullivan & Gray, Baton Rouge, La	16	4,000.00	15½	465.00
7	Israel R. Bobbitt, Baton Rouge, La	12⅞	3,218.75	14.96	448.80
8	R. M. Quigley & Co., St. Louis, Mo	14.99	3,747.50	13	390.00
10	Hayes Bros., Baton Rouge, La	13	3,250.00	14	420.00
11	P. J. Millett, Baton Rouge, La	17	4,250.00	17	510.00
12	D. B. Hearin & Co., Baton Rouge, La	.....	.....	13	390.00

No.	Name and address of bidder.	Elmer.		Rice, enlargement.	
		Embankment and excavations, 34,000 cubic yards.	Total cost of levee.	Embankment and excavations, 6,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
2	Donovan & Daley, Baton Rouge, La	*12.90	$4,386.00	14.40	$864.00
3	J. A. Carson, Baton Rouge, La	14	4,760.00	15	900.00
4	John Scott & Sons, St. Louis, Mo	14.7	4,998.00	14.7	882.00
5	C. D. Leeper & Co., Baton Rouge, La	16	5,440.00	16	960.00
6	Sullivan & Gray, Baton Rouge, La	14	4,760.00	13	780.00
7	Israel R. Robbitt, Baton Rouge, La	14.70	4,998.00	16	960.00
8	R. M. Quigley & Co., St. Louis, Mo	12.93	4,396.20	14.99	899.40
10	Hayes Bros., Baton Rouge, La	15	5,100.00	*9.95	597.00
11	P. J. Millett, Baton Rouge, La	17	5,780.00	12	720.00

No.	Name and address of bidder.	St. Elizabeth.		Tally Ho.		Old Hickory.	
		Embankment and excavations, 25,000 cubic yards.	Total cost of levee.	Embankment and excavations, 88,000 cubic yards.	Total cost of levee.	Embankment and excavations, 11,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*		*Cents.*	
1	John Treinen, Donaldsonville, La	.....	.....	.....	.....	12	$1,320
2	Donovan & Daley, Baton Rouge, La	13.90	$3,475.00	15.90	$13,992.00	11.40	1,254
3	J. A. Carson, Baton Rouge, La	15	3,750.00	15.45	13,596.00	11	1,210
4	John Scott & Sons, St. Louis, Mo	12.7	3,175.00	15.4	13,552.00	14	1,540
5	C. D. Leeper & Co., Baton Rouge, La	14	3,500.00	.....	.....	.....	.....
6	Sullivan & Gray, Baton Rouge, La	12.72	3,180.00	16.97	14,933.60	*10½	1,155
7	Israel R. Bobbitt, Baton Rouge, La	14⅞	3,718.75	14.74	12,971.20	12⅝	1,416
8	R. M. Quigley & Co., St. Louis, Mo	12.70	3,175.00	12.47	10,973.60	13	1,430
10	Hayes Bros., Baton Rouge, La	11	2,750.00	.....	.....	.....	.....
11	P. J. Millett, Baton Rouge, La	12	3,000.00	11½	10,120.00	11	1,210
12	D. B. Hearin & Co., Baton Rouge, La	.....	.....	.....	.....	11.40	1,254

St. Elizabeth and Tally Ho levees to be omitted in compliance with telegram from Chief of Engineers dated September 25, 1894.

Amount available	$161,000.00
Amount covered by this abstract	20,475.81
Balance	140,524.19

UNITED STATES ENGINEER OFFICE,
New Orleans, La., September 26, 1894.

No. 11 (1895).—*Abstract of proposals received in response to advertisement dated September 15, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received, and the bidders being considered responsible they are recommended for acceptance.]

PONTCHARTRAIN LEVEE DISTRICT.

No.	Name and address of bidder.	Jacobs.		Belmont.	
		Embankment and excavations, 28,000 cubic yards.	Total cost of levee	Embankment and excavations, 64,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	Sullivan & Gray, Baton Rouge, La	11.43	$3,200.40	15.93	$10,195.20
2	J. A. Carson, Baton Rouge, La	*10.99	3,077.20	15.75	10,080.00
7	Eltringham Construction Co., Natchez, Miss	.....	.....	14.74	9,433.60
8	R. M. Quigley & Co., St. Louis, Mo	14	3,920.00	14	8,960.00
9	Jno. Scott & Sons, St. Louis, Mo	13	3,640.00	14.9	9,536.00
10	C. D. Leeper & Co., Baton Rogue, La	13.3	3,724.00	16⅛	10,368.00
11	John Treinen, Donaldsonville, La	12.13	3,396.40	.....	.....
13	Israel R. Bobbitt, New Orleans, La	12⅜	3,465.00	14.90	9,536.00
14	D. B. Hearin & Co., Baton Rouge, La	12.90	3,612.00	.....	.....
15	Hayes Bros., Baton Rouge, La	14.75	4,130.00	15	9,600.00
16	Donovan & Daley, Baton Rogue, La	12⅛	3,453.33	17⅛	11,093.33
18	P. J. Millett, Baton Rouge, La	14	3,920.00	*14	8,960.00

No.	Name and address of bidder.	Frellsen.	
		Embankment and excavations, 31,000 cubic yards.	Total cost of levee.
		Cents.	
1	Sullivan & Gray, Baton Rouge, La	13½	$4,185.00
2	J. A. Carson, Baton Rouge, La	16	4,960.00
8	R. M. Quigley & Co., St. Louis, Mo	*13	4,030.00
9	Jno. Scott & Sons, St. Louis, Mo	13.9	4,309.00
10	C. D. Leeper & Co., Baton Rouge, La	19	5,890.00
13	Israel R. Bobbitt, Baton Rouge, La	13⅜	4,146.00
15	Hayes Bros., Baton Rouge, La	18	3,580.00
16	Donovan & Daley, Baton Rouge, La	16.90	5,239.00
18	P. J. Millett, Baton Rouge, La	15	4,650.00

LAFOURCHE LEVEE DISTRICT.

No.	Name and address of bidder.	Saulsberg.		Ferchaud.	
		Embankment and excavations, 25,000 cubic yards.	Total cost of levee.	Embankment and excavations, 16,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	Sullivan & Gray, Baton Rouge, La	10.22	$2,555.00	10.93	$1,748.80
2	J. A. Carson, Baton Rouge, La	14	3,500.00	15	2,400.00
9	Jno. Scott & Sons, St. Louis, Mo	11.7	2,925.00	16	2,560.00
10	C. D. Leeper & Co., Baton Rouge, La	13	3,250.00	14	2,240.00
11	John Treinen, Donaldsonville, La	*9	2,250.00	*10.68	1,708.80
13	Israel R. Bobbitt, Baton Rouge, La	11.70	2,925.00	10.90	1,744.00
15	Hayes Bros., Baton Rouge, La	11.95	2,987.50	18	2,880.00
16	Donovan & Daley, Baton Rouge, La	10.90	2,725.00	11.70	1,872.00

No. 11 (1895).—*Abstract of proposals received in response to advertisement dated September 13, 1894*—Continued.

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Getzinger.		Concord Upper.	
		Embankment and excavations, 21,000 cubic yards.	Total cost of levee.	Embankment and excavations, 14,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
2	J. A. Carson, Baton Rouge, La	16	$3,360.00	12	$1,680.00
4	Williford & Ryan, Dalcour, La			15½	2,170.00
5	R. B. Benton, New Orleans, La			14½	2,030.00
6	Martin Head, New Orleans, La			14¼	1,995.00
10	C. D. Leeper & Co., Baton Rouge, La	17	3,570.00	19½	2,695.00
12	Robt. McNamara, New Orleans, La	15	3,150.00	13	1,820.00
13	Israel R. Bobbitt, Baton Rouge, La	*13⅞	2,913.75	13.45	1,883.00
15	Hayes Bros., Baton Rouge, La	16	3,360.00	15	2,100.00
16	Donovan & Daley, Baton Rouge, La	19.90	4,179.00	12.70	1,778.00
17	John Cleary, New Orleans, La	18	3,780.00	13⅞	1,942.50
19	P. J. Tyrrell, New Orleans, La			12.99	1,818.60

No.	Name and address of bidder.	Concord Lower.	
		Embankment and excavations, 23,000 cubic yards.	Total cost of levee.
		Cents.	
2	J. A. Carson, Baton Rouge, La	*12	$2,760.00
3	P. J. Tyrrell, New Orleans, La	12.99	2,987.70
4	Williford & Ryan, Dalcour, La	12.19	2,803.70
5	R. B. Benton, New Orleans, La	13¾	3,105.00
6	Martin Head, New Orleans, La	14½	3,277.50
10	C. D. Leeper & Co., Baton Rouge, La	17	3,910.00
12	Robt. McNamara, New Orleans, La	13	2,990.00
13	Israel R. Bobbitt, Baton Rouge, La	13.45	3,093.50
15	Hayes Bros., Baton Rouge, La	15	3,450.00
16	Donovan & Daley, Baton Rouge, La	12.70	2,921.00
17	John Cleary, New Orleans, La	14⅞	3,421.25

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Caernarvon Upper.	
		Embankment and excavations, 23,000 cubic yards.	Total cost of levee.
		Cents.	
2	J. A. Carson, Baton Rouge, La	16	$3,680.00
4	Williford & Ryan, Dalcour, La	15.94	3,666.20
6	Martin Head, New Orleans, La	15.98	3,675.40
12	Robt. McNamara, New Orleans, La	*14	3,220.00
13	Israel R. Bobbitt, Baton Rouge, La	14.90	3,427.00
16	Donovan & Daley, Baton Rouge, La	14.90	3,427.00

REMARKS.—The bid of C. D. Leeper & Co. (No. 10) is as follows: Belmont Levee, original, 19.1, duplicate, 19 cents; Getzinger Levee, original, 17.1, duplicate, 17 cents; Concord Lower Levee, original, 17.1, duplicate, 17 cents.

No. 11 (1895).—*Abstract of proposals received in response to advertisement dated September 13, 1894 etc.*—Continued.

LAKE BORGUE LEVEE DISTRICT—Continued.

	Pontchartrain levee district.	Lafourche levee district.
Amount available	$82,856.07	$97,444.92
Amount covered by this abstract	16,067.20	3,958.80
Balance	66,788.87	93,486.12

	Barataria levee district.	Lake Borgne levee district.
Amount available	$68,456.00	$53,952.06
Amount covered by this abstract	7,353.75	3,220.00
Balance	61,102.25	50,732.06

UNITED STATES ENGINEER OFFICE,
New Orleans, La., October 10, 1894.

No. 12 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

ATCHAFALAYA LEVEE DISTRICT.

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance. The proposals for Picayuneville being considered too high are recommended for rejection.]

No.	Name and address of bidder.	Smithland. Embankment, 20,000 cubic yards.	Smithland. Excavations, 200 cubic yards.	Smithland. Total cost of levee.
		Cents.	*Cents.*	
1	Geo. W. Reagan, Red River Landing, La	15½	16	$3,182.00
5	J. A. Carson, Convent, La	17	17	3,434.00
7	John Scott & Sons, St. Louis, Mo	19.45	19.45	3,928.90
9	Edwin B. Helpason, Natchez, Miss	*12.95	*12	2,614.00

No.	Name and address of bidder.	Picayuneville. Embankment, 213,400 cubic yards.	Picayuneville. Excavations, 1,900 cubic yards.	Picayuneville. Total cost of levee.
		Cents.	*Cents.*	
7	John Scott & Sons, St. Louis, Mo	21.75	10	$46,604.50
11	R. M. Quigley & Co., St. Louis, Mo	20.69	20.69	44,545.57
12	C. D. Leeper & Co., Baton Rouge, La	29.9	.....	64,806.60

No.	Name and address of bidder.	Whitecastle. Embankment, 20,500 cubic yards.	Whitecastle. Excavations, 65 cubic yards.	Whitecastle. Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Baton Rouge, La	14.9	14.90	$3,064.18
3	Eltringham Construction Co., Natchez, Miss	15	15	3,084.75
4	Manning & Gibson, Oakwood, Miss	*13	*13	2,673.45
5	J. A. Carson, Convent, La	17	17	3,496.05
6	Donovan & Daley, Baton Rouge, La	14.90	14.90	3,064.18
7	John Scott & Sons, St. Louis, Mo	14.45	10	2,968.75
8	Hayes Bros., Baton Rouge, La	14	12	2,877.80
12	C. D. Leeper & Co., Baton Rouge, La	15.1	.....	3,095.50
13	James M. Sullivan, Baton Rouge, La	14	14	2,879.10

No. 12 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Dorceyville, enlargement.	
		Embankment, 11,000 cubic yards.	Total cost of levee.
		Cents.	
2	Israel R. Bobbitt, Amesville, La	15½	$1,705.00
3	Eltringham Construction Co., Natchez, Miss	15	1,650.00
4	Manning & Gibson, Oakwood, Miss	13.24	1,456.40
5	J. A. Carson, Convent, La	18	1,980.00
6	Donovan & Daley, Baton Rouge, La	19.70	2,167.00
8	Hayes Bros., Baton Rouge, La	*13	1,430.00
13	James M. Sullivan, Baton Rouge, La	13½	1,485.00

No.	Name and address of bidder.	Nodaway.		
		Embankment, 29,500 cubic yards.	Excavations, 40 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	15⅜	15⅜	$4,541.77
3	Eltringham Construction Co., Natchez, Miss	15	15	4,431.00
4	Manning & Gibson, Oakwood, Miss	14	14	4,135.60
5	J. A. Carson, Convent, La	18	18	5,317.20
6	Donovan & Daley, Baton Rouge, La	19.70	19	5,819.10
7	John Scott & Sons, St. Louis, Mo	15.45	10	4,561.75
8	Hayes Bros., Baton Rouge, La	15	10	4,429.00
12	C. D. Leeper & Co., Baton Rouge, La	14½		
13	James M. Sullivan, Baton Rouge, La	*12.93	*12.93	3,819.52

No.	Name and address of bidder.	Belle Grove.		
		Embankment, 50,000 cubic yards.	Excavations, 510 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	13.9	13.9	$7,020.89
3	Eltringham Construction Co., Natchez, Miss	12.70	12.70	6,414.77
4	Manning & Gibson, Oakwood, Miss	13	13	6,566.30
5	J. A. Carson, Convent, La	15	16	8,081.60
6	Donovan & Daley, Baton Rouge, La	*12.40	*12	6,261.20
7	John Scott & Sons, St. Louis, Mo	14	10	7,051.00
8	Hayes Bros., Baton Rouge, La	14½	11	7,306.10
12	C. D. Leeper & Co., Baton Rouge, La	13.9	13.9	7,020.89
13	James M. Sullivan, Baton Rouge, La	12.43	12.43	6,278.39

No.	Name and address of bidder.	Claiborne.		
		Embankment 98,850 cubic yards.	Excavations, 1,000 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	23	23	$22,965.50
3	Eltringham Construction Co., Natchez, Miss	22	10	21,847.00
4	Manning & Gibson, Oakwood, Miss	*15	*15	14,977.50
7	John Scott & Sons, St. Louis, Mo	17.95	10	17,843.57
8	Hayes Bros., Baton Rouge, La	16	16	15,976.00
11	R. M. Quigley & Co., St. Louis, Mo	19.70	19.70	19,670.45
12	C. D. Leeper & Co., Baton Rouge, La	16	16	15,976.00

No. 12 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Elise, enlargement.		
		Embankment 29,000 cubic yards.	Excavations, 300 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	13⅜	13⅜	$3,918.87
3	Eltringham Construction Co., Natchez, Miss	12.70	12.70	3,721.10
4	Manning & Gibson, Oakwood, Miss	13	13	3,809.00
5	J. A. Carson, Convent, La	16	16	4,688.00
6	Donovan & Daley, Baton Rouge La	11.85	11	3,469.50
7	John Scott & Sons, St. Louis, Mo	13.95	10	4,075.50
8	Hayes Bros., Baton Rouge, La	14	12	4,096.00
10	George Byrnes & Co., Baton Rouge, La	13	13	3,809.00
12	C. D. Leeper & Co., Baton Rouge, La	14	14	4,102.00
13	James M. Sullivan, Baton Rouge, La	*10.92	*10.92	3,199.56

No.	Name and address of bidder.	Modeste, enlargement.		
		Embankment, 13,000 cubic yards.	Excavations, 120 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	14⅜	14⅜	$1,886.00
3	Eltringham Construction Co., Natchez, Miss	13	13	1,705.60
4	Manning & Gibson, Oakwood, Miss	14.50	14.50	1,902.40
5	J. A. Carson, Convent, La	17	17	2,230.40
6	Donovan & Daley, Baton Rouge, La	13.39	13	1,756.30
7	John Scott & Sons, St. Louis, Mo	16.74	10	2,188.20
8	Hayes Bros., Baton Rouge, La	11	10	1,442.00
10	George Byrnes & Co., Baton Rouge, La	10¾	10¾	1,410.40
12	C. D. Leeper & Co., Baton Rouge, La	12	12	1,574.40
13	James M. Sullivan, Baton Rouge, La	*9.92	*9.92	1,301.50

No.	Name and address of bidder.	Landry.		
		Embankment, 7,000 cubic yards.	Excavations, 20 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	15½	15½	$1,088.10
3	Eltringham Construction Co., Natchez, Miss	13	13	912.60
5	J. A. Carson, Convent, La	18	18	1,263.60
6	Donovan & Daley, Baton Rouge, La	16.90	16	1,186.20
7	John Scott & Sons, St. Louis, Mo	20	10	1,402.00
8	Hayes Bros., Baton Rouge, La	12	10	842.00
11	C. D. Leeper & Co., Baton Rouge, La	15	15	1,053.00
13	James M. Sullivan, Baton Rouge, La	*11.72	*11.72	822.74

No.	Name and address of bidder.	Babin.		
		Embankment, 22,000 cubic yards.	Excavations, 250 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	13⅜	13⅜	$2,975.94
3	Eltringham Construction Co., Natchez, Miss	13	13	2,892.50
4	Manning & Gibson, Oakwood, Miss	13.24	13	2,945.30
5	J. A. Carson, Convent, La	16	16	3,560.00
6	Donovan & Daley, Baton Rouge, La	12.70	12	2,824.00
7	John Scott & Sons, St. Louis, Mo	16.45	10	3,644.00
8	Hayes Bros., Baton Rouge, La	14	10	3,105.00
10	Geo. Byrne & Co., Baton Rouge, La	13⅜	13⅜	3,003.75
12	C. D. Leeper & Co., Baton Rouge, La	14	14	3,115.00
13	James M. Sullivan, Baton Rouge, La	*11.40	*11.40	2,536.50

No. 12 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Smokebend.		
		Embankment, 35,000 cubic yards.	Excavations, 325 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	15½	15½	$5,475.37
3	Eltringham Construction Co., Natchez, Miss	14	14	4,945.50
4	Manning & Gibson, Oakwood, Miss	13	13	4,592.25
5	J. A. Carson, Convent, La	18	18	6,358.50
6	Donovan & Daley, Baton Rouge, La	14.70	14	5,190.50
7	John Scott & Sons, St. Louis, Mo	17.45	10	6,140.00
8	Hayes Bros., Baton Rouge, La	13	10	4,582.50
12	C. D. Leeper & Co., Baton Rouge, La	13.09	.....	.....
13	James M. Sullivan, Baton Rouge, La	*11.72	*11.72	4,140.09

Amount available	$115,205.43
Amount covered by this abstract	43,776.06
Balance	71,429.37

UNITED STATES ENGINEER OFFICE,
New Orleans, La., October 11, 1894.

No. 13 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance.]

LAFOURCHE LEVEE DISTRICT.

No.	Name and address of bidder.	Lauderdale, enlargement.		Pikes Peak, enlargement.	
		Embankment and excavations, 13,500 cubic yards.	Total cost of levee.	Embankment and excavations, 6,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
2	George Kilkenny, Baton Rouge, La	*12.15	$1,640.25	.....	.....
3	Geo. Byrnes & Co., Baton Rouge, La	14½	1,957.50	15½	$945.00
4	James M. Sullivan, Baton Rouge, La	12.23	1,651.05	*13.92	835.20
5	John Scott & Sons, St. Louis, Mo	18.95	2,558.25	20	1,200.00
6	John A. Carson, Baton Rouge, La	16	2,160.00	18	1,080.00
7	Hayes Bros., Baton Rouge, La	13	1,755.00	14	840.00
8	Eltringham Construction Co., Natchez, Miss	15	2,025.00	16	960.00
10	Israel R. Bobbitt, Amesville, La	14	1,890.00	15½	930.00
11	Donovan & Daley, Baton Rouge, La	.....	1,880.55	.....	.....
12	Treinen & Sauvage, Lauderdale, La	13.93	.....	.....	.....
13	R. M. Quigley & Co., St. Louis, Mo	.....	2,160.00	.....	.....
14	C. D. Leeper & Co., Baton Rouge, La	16	.....	15	900.00
17	Barbour & Ruple, La Place, La	15	2,025.00	17	1,020.00

No. 13 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

LAFOURCHE LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Laura enlargement.	
		Embankment and excavation, 6,300 cubic yards.	Total cost of levee.
		Cents.	
3	Geo. Byrnes & Co., Baton Rouge, La	16	$1,008.00
4	James M. Sullivan, Baton Rouge, La	14.25	897.75
5	John Scott & Sons, St. Louis, Mo	20	1,260.00
6	John A. Carson, Baton Rouge, La	18	1,134.00
7	Hayes Bros., Baton Rouge, La	*14	882.00
8	Eltringham Construction Co., Natchez, Miss	15	945.00
10	Israel R. Bobbitt, Amesville, La	15½	976.50
12	Treinen & Sauvage, Lauderdale, La	18	1,134.00
14	C. D. Leeper & Co., Baton Rouge, La	15½	976.50
17	Barbour & Ruple, La Place, La	16½	1,039.50

No.	Name and address of bidder.	Stevenson.		
		Embankment, 25,330 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	17½	17½	$4,450.25
5	John Scott & Sons, St. Louis, Mo	13.93	10	3,538.47
6	John A. Carson, Baton Rouge, La	14½	14½	3,687.35
7	Hayes Bros., Baton Rouge, La	16	10	4,062.80
8	Eltringham Construction Co., Natchez, Miss	14	14	3,560.20
10	Israel R. Bobbitt, Amesville, La	*13.40	*10	3,404.22
15	Manning & Gibson, Oakwood, Miss	16	16	4,068.80
16	D. B. Hearin & Co., Baton Rouge, La	16.50	16	4,195.45
17	Barbour & Ruple, La Place, La	16	16	4,068.80

No.	Name and address of bidder.	Songy.		
		Embankment, 60,000 cubic yards.	Excavations, 500 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	15	15	$9,075.00
5	John Scott & Sons, St. Louis, Mo	14.74	10	8,894.00
6	John A. Carson, Baton Rouge, La	16	14	9,670.00
7	Hayes Bros., Baton Rouge, La	*12	*8	7,240.00
8	Eltringham Construction Co., Natchez, Miss	12	12	7,200.00
10	Israel R. Bobbitt, Amesville, La	12⅝	10	7,475.00
13	R. M. Quigley & Co., St. Louis, Mo	13.93	13.93	8,427.65
14	C. D. Leeper & Co., Baton Rouge, La	16	16	9,680.00
15	Manning & Gibson, Oakwood, Miss	19	19	11,495.00
17	Barbour & Ruple, La Place, La	13.93	13	8,423.00

No.	Name and address of bidder.	Star.		
		Embankment, 20,000 cubic yards.	Excavations, 150 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	16½	16½	$3,324.75
5	John Scott & Sons, St. Louis, Mo	20	10	4,015.00
6	John A. Carson, Baton Rouge, La	16	14	3,221.00
7	Hayes Bros., Baton Rouge, La	14	10	2,815.00
8	Eltringham Construction Co., Natchez, Miss	*13	*13	2,619.50
10	Israel R. Bobbitt, Amesville, La	13⅜	12	2,693.00
15	Manning & Gibson, Oakwood, Miss	15.50	15.50	3,123.25
16	D. B. Hearin & Co., Baton Rouge, La	15.20	15	3,062.50
17	Barbour & Ruple, La Place, La	14½	12	2,843.00

No. 13 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

LAFOURCHE LEVEE DISTBICT—Continued.

No.	Name and address of bidder.	Madere.		
		Embankment, 10,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	15.22	15.22	$1,628.54
5	John Scott & Sons, St. Louis, Mo	20	10	2,120.00
6	John A. Carson, Baton Rouge, La	15	14	1,603.00
7	Hayes Bros., Baton Rouge, La	14	10	1,490.00
8	Eltringham Construction Co., Natchez, Miss	*13	*13	1,391.00
10	Israel R. Bobbitt, Amesville, La	17	12	1,809.00
17	Barbour & Ruple, La Place, La	15	12	1,599.00

No.	Name and address of bidder.	Alice Upper, enlargement.		
		Embankment, 7,800 cubic yards.	Excavations, 15 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	16	16	$1,250.40
6	John A. Carson, Baton Rouge, La	16	16	1,250.40
7	Hayes Bros., Baton Rouge, La	*14	*10	1,093.50
8	Eltringham Construction Co., Natchez, Miss	15	15	1,172.50
10	Israel R. Bobbitt, Amesville, La	15½	12	1,210.80
17	Barbour & Ruple, La Place, La	15	12	1,171.80

No.	Name and address of bidder.	Alice Lower.		
		Embankment, 20,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	16½	16½	$3,333.00
6	John A. Carson, Baton Rouge, La	17	16	3,432.00
8	Eltringham Construction Co., Natchez, Miss	14	14	2,828.00
10	Israel R. Bobbitt, Amesville, La	14½	12	2,924.00
15	Manning & Gibson, Oakwood, Miss	15.74	15.74	3,179.48

No.	Name and address of bidder.	Fortier.		
		Embankment, 10,500 cubic yards.	Excavations, 70 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	16.25	16.25	$1,717.62
6	John A. Carson, Baton Rouge, La	17	17	1,796.90
7	Hayes Bros., Baton Rouge, La	14	10	1,477.00
8	Eltringham Construction Co., Natchez, Miss	*13	*13	1,374.10
10	Israel R. Bobbitt, Amesville, La	17½	12	1,845.90
11	Donovan & Daley, Baton Rouge, La	16	16	1,691.20
15	Manning & Gibson, Oakwood, Miss	15.74	15.74	1,663.72

No.	Name and address of bidder.	Soniat, enlargement.		
		Embankment, 20,500 cubic yards.	Excavations, 325 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	17	17	$3,540.25
5	John Scott & Sons, St. Louis, Mo	23.9	10	4,932.00
6	John A. Carson, Baton Rouge, La	17	15	3,533.75
7	Hayes Bros., Baton Rouge, La	*13	*8	2,691.00
8	Eltringham Construction Co., Natchez, Miss	14	14	2,915.50
10	Israel Bobbitt, Amesville, La	16	12	3,319.00
17	Barbour & Ruple, La Place, La	15.74	15.74	3,277.85

No. 13 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

LAFOURCHE LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Odier.		Willswood, enlargement.	
		Embankment and excavations, 9,500 cubic yards.	Total cost of levee.	Embankment and excavations, 34,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
4	James M. Sullivan, Baton Rouge, La	14.25	$1,353.75	16½	$5,610.00
6	John A. Carson, Baton Rouge, La	17	1,615.00	18	6,120.00
7	Hayes Bros., Baton Rouge, La	14	1,330.00	* 12½	4,250.00
8	Eltringham Construction Co., Natchez, Miss	*13	1,235.00	14.90	5,066.00
10	Israel R. Bobbitt, Amesville, La	16	1,520.00	15⅞	5,397.50
11	Donovan & Daley, Baton Rouge, La			13.90	4,726.00

PONTCHARTRAIN LEVEE DISTRICT.

No.	Name and address of bidder.	Gourrier.		
		Embankment, 76,500 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	19.97	19.97	$15,297.02
5	John Scott & Sons, St. Louis, Mo	16.73	10	12,808.45
6	John A. Carson, Baton Rouge, La	18.99	16	14,543.35
7	Hayes Bros., Baton Rouge, La	18	10	13,780.00
8	Eltringham Construction Co., Natchez, Miss	* 15.40	* 14	11,795.00
10	Israel R. Bobbitt, Amesville, La	17⅞	12	13,303.87
11	Donovan & Daley, Baton Rouge, La	19	19	14,554.00
13	R. M. Quigley & Co., St. Louis, Mo	15.74	15.74	12,056.84
14	C. D. Leeper & Co., Baton Rouge, La	21	21	16,086.00
15	Manning & Gibson, Oakwood, Miss	19	19	14,554.00

No.	Name and address of bidder.	Darrowville.		
		Embankment, 35,000 cubic yards.	Excavations, 150 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	George Kilkenny, Baton Rouge, La	* 10.40	* 10	$3,655.00
4	James M. Sullivan, Baton Rouge, La	14.25	14.25	5,008.87
5	John Scott & Sons, St. Louis, Mo	13	10	4,565.00
6	John A. Carson, Baton Rouge, La	14½	14	5,096.00
7	Hayes Bros., Baton Rouge, La	13	8	4,562.00
8	Eltringham Construction Co., Natchez, Miss	12	12	4,218.00
10	Israel R. Bobbitt, Amesville, La	12.9	12	4,533.00
11	Donovan & Daley, Baton Rouge, La	17	17	5,975.50
13	R. M. Quigley & Co., St. Louis, Mo	16	16	5,624.00
15	Manning & Gibson, Oakwood, Miss	19	19	6,678.50

No.	Name and address of bidder.	Bagatelle, new and enlargement.		
		Embankment, 16,000 cubic yards.	Excavations. 50 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	George Kilkenny, Baton Rouge, La	* 11.15	* 10	$1,789.00
3	George Byrne & Co., Baton Rouge, La	17	17	2,728.50
4	James M. Sullivan, Baton Rouge, La	12.93	12.93	2,075.26
6	John A. Carson, Baton Rouge, La	13	10	2,085.00
7	Hayes Bros., Baton Rouge, La	14	8	2,244.00
8	Eltringham Construction Co., Natchez, Miss	12.90	12.90	2,070.45
10	Israel R. Bobbitt, Amesville, La	14	12	2,246.00
11	Donovan & Daley, Baton Rouge, La	15	15	2,407.50
12	Treinen & Sauvage, Lauderdale, La	17.98	17.98	2,885.79
14	C. D. Leeper & Co., Baton Rouge, La	16	16	2,568.00
16	D. B. Hearin & Co., Baton Rouge, La	15	15	2,407.50
17	Barbour & Ruple, La Place, La	14.93	12	2,394.80

No. 13 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

PONTCHARTRAIN LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	David, new and enlargement.		
		Embankment, 33,000 cubic yards.	Excavations, 400 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	12.46	12.46	$4,161.64
5	John Scott & Sons, St. Louis, Mo	13.49	10	4,491.70
6	John A. Carson, Baton Rouge, La	14	10	4,660.00
7	Hayes Bros., Baton Rouge, La	12½	8	4,157.00
8	Eltringham Construction Co., Natchez, Miss	*12	*12	4,008.00
10	Israel R. Bobbitt, Amesville, La	12.9	12	4,305.00
14	C. D. Leeper & Co., Baton Rouge, La	13½	13½	4,509.00
15	Manning & Gibson, Oakwood, Miss	12.99	12.99	4,333.66
16	D. B. Hearin & Co., Baton Rouge, La	13	13	4,342.00
17	Barbour & Ruple, La Place, La	14.43	12	4,809.90

No.	Name and address of bidder.	Old Church.		
		Embankment, 8,600 cubic yards.	Excavations, 50 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	James M. Sullivan, Baton Rouge, La	14	14	$1,211.00
5	John Scott & Sons, St. Louis, Mo	15	10	1,295.00
6	John A. Carson, Baton Rouge, La	14	10	1,209.00
7	Hayes Bros., Baton Rouge, La	*14	*8	1,208.00
8	Eltringham Construction Co., Natchez, Miss	14	14	1,211.00
10	Israel R. Bobbitt, Amesville, La	14	12	1,210.00
14	C. D. Leeper & Co., Baton Rouge, La	14½	14½	1,254.25
16	D. B. Hearin & Co., Baton Rouge, La	14	14	1,211.00
17	Barbour & Ruple, La Place, La	14	12	1,210.00

No.	Name and address of bidder.	Kenner.		
		Embankment, 33,750 cubic yards.	Excavations, 400 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	John Cleary, New Orleans, La	16	16	$5,464.00
4	James M. Sullivan, Baton Rouge, La	14½	14½	4,961.75
5	John Scott & Sons, St. Louis, Mo	14.45	10	4,916.87
6	John A. Carson, Baton Rouge, La	18	16	6,139.00
7	Hayes Bros., Baton Rouge, La	13.95	13.95	4,763.92
8	Eltringham Construction Co., Natchez, Miss	14.4	14.4	4,917.60
9	Williford & Ryan, Dalcour, La	*12.69	*12.69	4,333.63
10	Israel R. Bobbitt, Amesville, La	13⅜	12	4,688.62
13	R. M. Quigley & Co., St. Louis, Mo	14.99	14.99	5,119.08

It is recommended that bids for Alice Lower levee be rejected for the reason that it now appears that work is not urgent this year.

	Lafourche levee district.	Pontchartrain levee district.
Amount available	$93,000.00	$66,000.00
Amount covered by this abstract	28,655.77	26,788.63
Balance	64,344.23	39,211.37

UNITED STATES ENGINEER OFFICE,
New Orleans, La., October 12, 1894.

No. 14 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance. The bids received for the following levees are recommended for rejection for the reason that the prices are considered too high: Barataria levee district, Kearney Lower, Star Upper (new and enlargement) La Reussite, Purcelle, La Rose, Hermitage, Woodland, Lake Borgne levee district, Burbridge, Collette, Davis, Louisiana Store, and Belair.]

LOWER TENSAS LEVEE DISTRICT.

No.	Name and address of bidder.	Hard Times-Wilson, enlargement.		
		Embankment, 25,000 cubic yards.	Excavations, 1,000 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	John Scott & Sons, St. Louis, Mo.	22½	20	$6,087.50
2	Edwin B. Helgason, Natchez, Miss.	23	22	6,190.00
5	John A. Carson, Convent, La.	18	18	4,860.00
8	James R. Marlow, Natchez, Miss.	*17.70	*17.70	4,779.00
12	Garbish & O'Neil, Memphis, Tenn.	18⅜	18⅜	4,960.87

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Bell.		
		Embankment, 20,250 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La.	22	20	$4,475.00
10	Israel R. Bobbitt, Amesville, La.	*13¾	*12	2,796.37

No.	Name and address of bidder.	Browns.		
		Embankment, 5,200 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La.	25	25	$1,350.00
6	John Cleary, New Orleans, La.	16	16	864.00
10	Israel R. Bobbitt, Amesville, La.	*14½	*12	797.50

No.	Name and address of bidder.	Kearney, Lower.		
		Embankment, 10,100 cubic yards.	Excavations, 15 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La.	22	22	$2,225.30
6	John Cleary, New Orleans, La.	15	15	1,517.25
10	Israel R. Bobbitt, Amesville, La.	14½	12	1,504.17

No.	Name and address of bidder.	Cedar Grove.		
		Embankment, 29,000 cubic yards.	Excavations, 600 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Donovan & Daley, Baton Rouge, La.	14.90	9	$4,375.00
5	John A. Carson, Convent, La.	17	15	5,020.00
6	John Cleary, New Orleans, La.	14½	14½	4,403.00
10	Israel R. Bobbitt, Amesville, La.	*14.75	*12	4,349.50
11	Martin Head, New Orleans, La.	16	16	4,736.00

No. 14 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

BARATARIA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Sarah.		
		Embankment, 28,700 cubic yards.	Excavations, 500 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Donovan & Daley, Baton Rouge, La	*13.39	*9	$3,887.93
5	John A. Carson, Convent, La	20	10	5,790.00
6	John Cleary, New Orleans, La	15⅞	15⅞	4,635.49
10	Israel R. Bobbitt, Amesville, La	14⅝	12	4,185.62

No.	Name and address of bidder.	Star Upper, new and enlargement.		
		Embankment, 10,000 cubic yards.	Excavations, 3,700 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	26½	26½	$3,630.50
5	John A. Carson, Convent, La	19	19	2,603.00
10	Israel R. Bobbitt, Amesville, La	18	15½	2,373.50

No.	Name and address of bidder.	La Réussite.		
		Embankment, 5,500 cubic yards.	Excavations, 300 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	25	25	$1,450.00
10	Israel R. Bobbitt, Amesville, La	16½	12	943.50

No.	Name and address of bidder.	Purcelle.		
		Embankment, 15,100 cubic yards.	Excavations, 150 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	14.9	14.9	$2,272.25
5	John A. Carson, Convent, La	16	16	2,440.00
10	Israel R. Bobbitt, Amesville, La	16	12	2,434.00

No.	Name and address of bidder.	La Rose.		
		Embankment, 7,000 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	14.9	14.9	$1,057.90
5	John A. Carson, Convent, La	25	25	1,775.00
10	Israel R. Bobbitt, Amesville, La	16	12	1,132.00

No.	Name and address of bidder.	Woodland.		
		Embankment, 9,500 cubic yards.	Excavations, 600 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	20	20	$2,020.00
9	John King, New Orleans, La	24	21	2,406.00
10	Israel R. Bobbitt, Amesville, La	18	12	1,782.00

No. 14 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

BARATARIA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Hermitage. Embankment, 2,700 cubic yards	Excavations, 50 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	30	30	$825.00
10	Israel R. Bobbitt, Amesville, La	18	12	492.00

No.	Name and address of bidder.	Riceland. Embankment, 11,300 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	17	17	$1,938.00
10	Israel R. Bobbitt, Amesville, La	18	12	2,046.00
11	Martin Head, New Orleans, La	*16½	*16½	1,881.00

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Stella Upper. Embankment, 1,750 cubic yards.	Excavations, 25 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	30	30	$532.50
7	Williford & Ryan, Dalcour, La	16.74	20	297.95
9	John King, New Orleans, La	18½	18½	328.37
10	Israel R. Bobbitt, Amesville, La	*16½	*12	291.75

No.	Name and address of bidder.	Fanny. Embankment, 17,500 cubic yards.	Excavations, 150 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	15½	15½	$2,735.75
5	John A. Carson, Convent, La	17	17	3,000.50
7	Williford & Ryan, Dalcour, La	14.99	15	2,645.75
9	John King, New Orleans, La	21	21	3,706.50
10	Israel R. Bobbitt, Amesville, La	15½	12	2,730.50
11	Martin Head, New Orleans, La	*12½	*12½	2,272.43

No.	Name and address of bidder.	Belair. Embankment, 22,600 cubic yards.	Excavations, 2,000 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	25	25	$6,150.00
10	Israel R. Bobbitt, Amesville, La	17	15	4,142.00
11	Martin Head, New Orleans, La	16½	16½	4,059.00

No. 14 (1895.)—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

LAKE BORGNE LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Fairview Upper.		
		Embankment, 39,850 cubic yards.	Excavations, 300 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	16	16	$6,424.00
7	Williford & Ryan, Dalcour, La	22	20	8,827.00
10	Israel R. Bobbitt, Amesville, La	*13.90	*12	5,575.15
11	Martin Head, New Orleans, La	16½	16½	6,624.75

No.	Name and address of bidder.	Fairview.		
		Embankment, 14,000 cubic yards.	Excavations, 400 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	14	*14	$2,016.00
5	John A. Carson, Convent, La	17	17	2,448.00
10	Israel R. Bobbitt, Amesville, La	14.90	12	2,134.00
11	Martin Head, New Orleans, La	16½	16½	2,376.00

No.	Name and address of bidder.	Fairview Lower.		Burbridge, enlargement.	
		Embankment and excavations, 5,500 cubic yards.	Total cost of levee.	Embankment and excavations, 5,600 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
4	Robert McNamara, New Orleans, La	*14	$770.00		
5	John A. Carson, Convent, La	20	1,100.00	30	$1,680.00
9	John King, New Orleans, La	18	990.00	21	1,176.00
10	Israel R. Bobbitt, Amesville, La	16	880.00	17	952.00

No.	Name and address of bidder.	Monsecour.		
		Embankment, 27,200 cubic yards.	Excavations, 650 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
4	Robert McNamara, New Orleans, La	*13¾	*13¾	$3,829.37
5	John A. Carson, Convent, La	18	18	5,013.00
9	John King, New Orleans, La	16½	15	4,585.50
10	Israel R. Bobbitt, Amesville, La	16	12	4,430.00
11	Martin Head, New Orleans, La	16½	16½	4,595.25

No.	Name and address of bidder.	Collette.		
		Embankment, 15,400 cubic yards.	Excavations, 375 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	18	18	$2,839.50
9	John King, New Orleans, La	15.99	15.99	2,522.42
10	Israel R. Bobbitt, Amesville, La	17	12	2,663.00

No. 14 (1895).—*Abstract of proposals received in response to advertisement dated September 27, 1894, etc.*—Continued.

LAKE BORGNE LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Davis.		
		Embankment, 5,900 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	20	20	$1,220.00
10	Israel R. Bobbitt, Amesville, La	18	12	1,086.00

No.	Name and address of bidder.	Louisiana Store.		
		Embankment, 4,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
5	John A. Carson, Convent, La	19	19	$798.00
9	John King, New Orleans, La	17	15	710.00
10	Israel R. Bobbitt, Amesville, La	18	12	744.00

	Lower Tensas levee district.	Barataria levee district.	Lake Borgne levee district.
Amounts available	$60,000.00	$61,000.00	$50,700.00
Amounts covered by this abstract	4,779.00	10,915.93	14,754.70
Balance	55,221.00	50,084.07	35,945.30

UNITED STATES ENGINEER OFFICE,
New Orleans, La., October 31, 1894.

No. 15 (1895).—*Abstract of proposals received in response to advertisement dated October 22, 1894, opened this day by Capt. John Millis, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received and the bidders being considered responsible, they are recommended for acceptance. The bids received for Kempe Levee, middle section, are recommended for rejection on account of lack of funds. The bids received for Belair Levee are recommended for rejection, owing to objection to location of line of levee.]

LOWER TENSAS LEVEE DISTRICT.

No.	Name and address of bidder.	Kempe, upper section.		Kempe, middle section.	
		Embankment and excavations, 60,000 cubic yards.	Total cost of levee.	Embankment and excavations, 60,000 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	F. M. McLaughlin, Natchez, Miss	42	$25,200.00	38	$22,800.00
2	John Scott & Sons, St. Louis, Mo	37	22,200.00	37	22,200.00
7	C. H. Dameron & Co., Baton Rouge, La	37	22,200.00	38½	23,100.00
10	W. J. Bentley, New Orleans, La	*32.2	19,320.00	33.2	19,920.00

No. 15 (1895).—*Abstract of proposals received in response to advertisement dated October 22, 1894, etc.*—Continued.

LOWER TENSAS LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Kempe, lower section.	
		Embankment and excavations, 60,000 cubic yards.	Total cost of levee.
		Cents.	
1	F. M. McLaughlin, Natchez, Miss.	25½	$15,300.00
2	John Scott & Sons, St. Louis, Mo.	32⅝	19,500.00
7	C. H. Dameron & Co., Baton Rouge, La.	33.99	20,394.00
10	W. J. Bentley & Co., New Orleans, La.	27.2	16,320.00
12	A. P. Martin, Waterproof, La.	*23	13,800.00

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Kearney Lower.		
		Embankment, 10,100 cubic yards.	Excavations, 15 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La.	14.9	10	$1,506.40
5	John A. Carson, Convent, La.	*14	*14	1,416.10
6	Israel R. Bobbitt, Amesville, La.	15½	12	1,567.30
11	John Cleary, New Orleans, La.	14⅛	14⅛	1,466.67

No.	Name and address of bidder.	Concession.		
		Embankment, 21,410 cubic yards.	Excavations, 1,200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La.	*14.20	*10	$3,160.00
4	Martin Head, New Orleans, La.	15	15	3,391.50
5	John A. Carson, Convent, La.	22	20	4,950.20
6	Israel R. Bobbitt, Amesville, La.	15.70	12	3,505.37

No.	Name and address of bidder.	Star Upper, new and enlargement.		
		Embankment, 22,000 cubic yards.	Excavations, 3,300 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La.	16	16	$4,144.00
4	Martin Head, New Orleans, La.	*15½	*15½	4,079.25
6	Israel R. Bobbitt, Amesville, La.	17	16	4,364.00
8	John King, New Orleans, La.	18	18	4,662.00

No.	Name and address of bidder.	La Reussite.		
		Embankment, 5,500 cubic yards.	Excavations, 300 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La.	*16	*10	$910.00
5	John A. Carson, Convent, La.	16	16	928.00
6	Israel R. Bobbitt, Amesville, La.	15.90	12	910.00
8	John King, New Orleans, La.	16.74	16.74	970.92

No. 15 (1895).—*Abstract of proposals received in response to advertisement dated October 22, 1894, etc.*—Continued.

BARATARIA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Purcelle.		
		Embankment, 15,100 cubic yards.	Excavations, 150 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	*14.75	*10	$2,242.25
5	John A. Carson, Convent, La	16	15	2,438.50
6	Israel R. Bobbitt, Amesville, La	15.90	12	2,418.90

No.	Name and address of bidder.	La Rose.		
		Embankment, 7,000 cubic yards.	Excavations, 100 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	*14.75	*10	$1,042.50
5	John A. Carson, Convent, La	18	18	1,278.00
6	Israel R. Bobbitt, Amesville, La	15.90	12	1,125.00
8	John King, New Orleans, La	16.99	16	1,205.30

No.	Name and address of bidder.	Hermitage.		
		Embankment, 2,700 cubic yards.	Excavations, 50 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	*15	*10	$410.00
6	Israel R. Bobbitt, Amesville, La	17	12	465.00
8	John King, New Orleans, La	16.41	16.41	451.27

No.	Name and address of bidder.	Woodland.		
		Embankment, 9,500 cubic yards.	Excavations, 600 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	*14.75	*10	$1,461.25
6	Israel R. Bobbitt, Amesville, La	17	12	1,687.00
8	John King, New Orleans, La	19.99	19.99	2,019.00

No.	Name and address of bidder.	West Pointe a la Hache.		
		Embankment, 12,000 cubic feet.	Excavations, 700 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	*16	*16	$2,032.00
6	Israel R. Bobbitt, Amesville, La	18	12	2,244.00

No. 15 (1895).—*Abstract of proposals received in response to advertisement dated October 22, 1894, etc.*—Continued.

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Belair.		
		Embankment, 22,600 cubic yards.	Excavations, 2,000 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	14.70	12	$3,562.20
4	Martin Head, New Orleans, La	14½	14½	3,567.00
5	John A. Carson, Convent, La	16	16	3,936.00
6	Israel R. Bobbitt, Amesville, La	15.90	12	3,833.40

No.	Name and address of bidder.	Burbridge, enlargement.	
		Embankment and excavations, 5,600 cubic yards.	Total cost of levee.
		Cents.	
3	Barbour & Ruple, La Place, La	15	$840.00
6	Israel R. Bobbitt, Amesville, La	16	896.00
8	John King, New Orleans, La	17½	980.00

No.	Name and address of bidder.	Collette.		
		Embankment, 15,400 cubic yards.	Excavations, 375 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	14.20	10	$2,224.30
5	John A. Carson, Convent, La	17	17.	2,681.75
6	Israel R. Bobbitt, Amesville, La	16	12	2,509.00
8	John King, New Orleans, La	13.99	13.99	2,206.92
9	John F. Brennan, New Orleans, La	*13.47	*13.47	2,124.89
11	John Cleary, New Orleans, La	13½	13½	2,129.62
13	F. C. Mevers, Pointe a la Hache, La	14	18	2,223.50

No.	Name and address of bidder.	Davis.		
		Embankment, 5,900 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	14.20	10	$857.80
6	Israel R. Bobbitt, Amesville, La	16	12	968.00
8	John King, New Orleans, La	18½	18½	1,128.50
9	John F. Brennan, New Orleans, La	14.49	14.49	883.89
11	John Cleary, New Orleans, La	*13½	*13	822.50
13	F. C. Mevers, Pointe a la Hache, La	14	18	862.00

No.	Name and address of bidder.	Louisiana Store.		
		Embankment, 4,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Barbour & Ruple, La Place, La	14.20	10	$588.00
6	Israel R. Bobbitt, Amesville, La	16½	12	684.00
8	John King, New Orleans, La	13.99	13.99	587.58
11	John Cleary, New Orleans, La	*13½	*13	566.00
13	F. C. Mevers, Pointe a la Hache, La	17	18	716.00

No. 15 (1895.)—*Abstract of proposals received in response to advertisement dated October 22, 1894, etc.*—Continued.

LAKE BORGNE LEVEE DISTRICT—Continued.

	Lower Tensas levee district.	Barataria levee district.	Lake Borgne levee district.
Amounts available	$40,700.00	$43,190.06	$26,426.13
Amount covered by this abstract	33,120.00	16,753.57	4,353.39
Balances	7,580.00	26,436.49	22,072.74

UNITED STATES ENGINEER OFFICE,
New Orleans, La., November 12, 1894.

No. 16 (1895).—*Abstract of proposals received in response to advertisement dated October 29, 1894, opened this day by Maj. James B. Quinn, Corps of Engineers, for levee revetment work in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance.]

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Section A (3,893 linear feet).		Section B (5,694 linear feet).		Section C (3,587 linear feet).	
		Per foot.	Amount.	Per foot.	Amount.	Per foot.	Amount.
		Cents.		*Cents.*		*Cents.*	
1	Henry C. Brown, New Orleans, La	60	$2,335.80	60	$3,416.40	60	$2,152.20
2	John F. Herbert, Harvey, La	54.75	2,131.41				
3	Andrew Downey, New Orleans, La	54	2,102.22	54	3,074.76	54	1,936.98
4	J. A. Andrews & Son, Baton Rouge, La	66	2,569.38	62	3,530.28	60	2,152.20
5	R. M. Quigley & Co., St. Louis, Mo	*49.5	1,927.03	*50	2,847.00	50	1,793.50
6	Robt. McNamara, jr., New Orleans, La			73	4,156.62	65	5,331.55
8	F. M. McLaughlin, Memphis, Tenn	58	2,257.94	58	3,302.52	57	2,044.59
9	Geo. B. Sanchin, New Orleans, La	70	2,725.10	66	3,758.04	60	2,152.20
11	Barbour & Ruple, La Place, La	52.24	2,033.70	51.78	2,948.35	*41.45	1,486.81
12	Eltringham Construction Co., Natchez, Miss	63	2,452.59	60	3,416.40	58	2,080.46

No.	Name and address of bidder.	Section D (4,529 linear feet).		Section E (3,693 linear feet).		Section F (1,298 linear feet).	
		Per foot.	Amount.	Per foot.	Amount.	Per foot.	Amount.
		Cents.		*Cents.*		*Cents.*	
1	Henry C. Brown, New Orleans, La	60	$2,717.40	60	$2,215.80	75	$973.50
3	Andrew Downey, New Orleans, La	54	2,445.66	54	1,994.22	54	700.92
4	J. A. Andrews & Son, Baton Rouge, La	60	2,717.40	60	2,215.80	60	778.80
5	R. M. Quigley & Co., St. Louis, Mo	49.5	2,241.85	49	1,809.57	49	636.02
6	Robt. McNamara, jr., New Orleans, La	65	2,943.85	65	2,445.00	63	817.74
7	John Cleary, New Orleans, La					59	765.82
8	F. M. McLaughlin, Memphis, Tenn	58	2,626.82	58	2,141.94	58	752.84
9	Geo. B. Sanchin, New Orleans, La	64	2,898.56	63	2,326.59	62	804.76
10	E. J. Morris, Ocean Springs, Miss					80	1,038.40
11	Barbour & Ruple, La Place, La	*45.47	1,108.55	*46	676.66	*46.4	602.27
12	Eltringham Construction Co., Natchez, Miss	58	2,626.82	58	2,141.94	62	804.76

No. 16 (1895.)—*Abstract of proposals received in response to advertisement dated October 29, 1894*—Continued.

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Section G (1,591 linear feet).		Section H (2,602 linear feet).	
		Per foot.	Amount.	Per foot.	Amount.
		Cents.		*Cents.*	
1	Henry C. Brown, New Orleans, La	58	$922.78	58	$1,509.16
3	Andrew Downey, New Orleans, La	54	859.14	54	1,405.08
4	J. A. Andrews & Son, Baton Rouge, La	62	986.42	60	1,561.20
5	R. M. Quigley & Co., St. Louis, Mo	*50	795.50	51	1,327.02
6	Robt. McNamara, jr., New Orleans, La	68	1,081.88	63	1,639.26
7	John Cleary, New Orleans, La	59	938.69	59	1,535.18
8	F. M. McLaughlin, Memphis, Tenn	58	922.70	58	1,509.16
9	Geo. B. Sanchin, New Orleans, La	71	1,129.61	63	1,639.26
10	E. J. Morris, Ocean Springs, Miss	80	1,272.80	80	2,081.60
11	Barbour & Ruple, La Place, La	50.88	809.50	45	1,183.12
12	Eltringham Construction Co., Natchez, Miss	62	986.42	60	1,561.20

The number of linear feet of revetment in Section G, Lake Borgne district, has been reduced from 5,227 to 1,591, owing to the omission of Belair and Fanny levees. The number of linear feet in Section D has been reduced from 4,529 to 2,438, on account of the omission of Purcelle levee. The number of linear feet in Section E has been reduced from 3,693 to 1,471, on account of the omission of West Pointe a la Hache levee. The lowest bidders state that they are willing to construct revetment in the different sections as reduced at the same prices as bid on the original number of linear feet. The calculations in the foregoing abstract for the successful bids are based on the reduced amounts.

It is recommended that all bids on Section H be rejected on account of the omission of the Collette and Louisiana Store levees.

	Barataria levee district.	Lake Borgne levee district.
Amount available	$26,400.00	$22,000.00
Amount covered by this abstract	8,046.05	1,397.77
Balance	18,353.95	20,602.23

UNITED STATES ENGINEER OFFICE,
New Orleans, La., November 23, 1894.

No. 17 (1895).—*Abstract of proposals received in response to advertisement dated November 12, 1894, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[Proposals marked thus * are the lowest received, and the bidders being considered responsible, they are recommended for acceptance.]

ATCHAFALAYA LEVEE DISTRICT.

No.	Name and address of bidder.	Nina, enlargement.		Point Pleasant, new and enlargement.		
		Embankment and excavations, 22,000 cubic yards.	Total cost of levee.	Embankment, 20,500 cubic yards.	Excavations, 120 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	*Cents.*	
1	Manning & Gibson, Whitecastle, La	.....	.....	14	14	$2,886.80
3	E. B. Helgason, Natchez, Miss	18	$3,960.00	11.7	10	2,410.50
4	Donovan & Daley, Baton Rouge, La	27	5,940.00	11½	10	2,446.37
6	Eltringham Construction Co., Natchez, Miss	*13.18	2,899.60	12.45	12.45	2,567.19
7	Sullivan & Gray, Baton Rouge, La	16½	3,630.00	10.92	8	2,248.20
9	Tansy & Kilkenny, Darrowville, La	.....	.....	10.75	12	2,218.15
10	Ed. Keogh & Co., St. Louis, Mo	22	4,840.00	15	15	3,093.00
11	J. A. Andrew & Son, Baton Rouge, La	21	4,620.00	13	13	2,680.60
12	Hayes Bros., Baton Rouge, La	.....	.....	14	12	2,884.40
13	George Byrne & Co., Baton Rouge, La	.....	.....	*8.94	*2.50	1,842.90
14	John A. Carson, Concession, La	16	3,520.00	14½	14	2,989.30

No. 17 (1895).—*Abstract of proposals received in response to advertisement dated November 12, 1894, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	St. Raphael, enlargement.		
		Embankment, 22,500 cubic yards.	Excavations, 65 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Manning & Gibson, Whitecastle, La	13	13	$2,933.45
3	E. B. Helgason, Natchez, Miss	11.9	5	2,680.75
4	Donovan & Daley, Baton Rouge, La	10½	10	2,453.37
6	Eltringham Construction Co., Natchez, Miss	12.45	12.45	2,809.34
7	Sullivan & Gray, Baton Rouge, La	11.92	8	2,687.20
9	Tansy & Kilkenny, Darrowville, La	12	12	2,707.80
10	Ed. Keogh & Co., St. Louis, Mo	18	18	4,061.70
11	J. A. Andrews & Son, Baton Rouge, La	13	10	2,931.50
12	Hayes Bros., Baton Rouge, La	14	12	3,157.80
13	George Byrne & Co., Baton Rouge, La	*10½	*10½	2,425.73
14	J. A. Carson, Concession, La	16½	16	3,722.90

LAFOURCHE LEVEE DISTRICT.

No.	Name and address of bidder.	Willow Grove.		
		Embankment, 26,000 cubic yards.	Excavations, 180 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Manning & Gibson, Whitecastle, La	13	13	$3,403.40
2	Israel R. Bobbitt, Amesville, La	12.78	12	3,369.10
4	Donovan & Daley, Baton Rouge, La	11½	10	2,964.67
5	C. D. Leeper & Co., Baton Rouge, La	13.2	.....	.....
6	Eltringham Construction Co., Natchez, Miss	12.45	12.45	3,259.41
7	Sullivan & Gray, Baton Rouge, La	*10.72	*8	2,801.60
8	Treinen & Savage, Saulsborg, La	12.90	.....	.....
9	Tansey & Kilkenny, Darrowville, La	11½	10	3,008.00
10	Ed. Keogh & Co., St. Louis, Mo	10.75	10.75	2,814.35
11	J. A. Andrews & Son, Baton Rouge, La	13	10	3,398.00
12	Hayes Bros., Baton Rouge, La	13	9	3,396.20
14	J. A. Carson, Concession, La	12.99	12	3,399.00
15	Barbour & Ruple, La Place, La	13.70	10	3,500.00

No.	Name and address of bidder.	Starlight.		
		Embankment, 69,500 cubic yards.	Excavations, 550 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Israel R. Bobbitt, Amesville, La	15.96	12	$11,158.20
5	C. D. Leeper & Co., Baton Rouge, La	15½	.....	.....
6	Eltringham Construction Co., Natchez, Miss	16.38	16.38	11,474.19
7	Sullivan & Gray, Baton Rouge, La	14.72	10	10,285.40
10	Ed. Keogh & Co., St. Louis, Mo	*12	*12	8,406.00
11	J. A. Andrews & Son, Baton Rouge, La	14½	14½	10,157.25
14	J. A. Carson, Concession, La	16	16	11,208.00
15	Barbour & Ruple, La Place, La	15.20	12	10,630.00
16	John Cleary, New Orleans, La	26	26	18,213.00

	Atchafalaya levee district.	Lafourche levee district.
Amount available	$70,735.06	$62,599.40
Amount covered by this abstract	7,168.23	11,207.60
Balance	63,566.83	51,391.80

UNITED STATES ENGINEER OFFICE,
New Orleans, La., January 10, 1895.

No. 18 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated December 31, 1894, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

ATCHAFALAYA LEVEE DISTRICT.

[The bids marked thus * have been accepted. They are the lowest bids received and are considered reasonable. Copies of the letters of acceptance are filed with the bids.]

No.	Name and address of bidder.	Anchorage, enlargement.		
		Embankment, 10,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Thomas O'Malley, Baton Rouge, La	18¼	18	$1,923.50
3	Israel R. Bobbitt, Belair, La	12.96	12.96	1,321.92
4	G. W. Reagan, Red River Landing, La	16¾	16¾	1,708.50
5	Geo. Kilkenny, Baton Rouge, La	13¾	13¾	1,402.50
6	James R. Marlow, Natchez, Miss	16	16	1,632.00
7	C. D. Leeper, Hester, La	14.1	1	1,412.00
8	Michael Hanick, Plaquemine, La	15		
9	James M. Sullivan, Baton Rouge, La	*12.20	*12.20	1,244.40
10	Mike Tansy, Smoke Bend, La	13	11	1,322.00
11	Donovan & Daley, Whitecastle, La	16.70	16.70	1,703.40
12	J. A. Carson, Concession, La	14.99	15	1,529.00

No.	ame and address of bidder.	Uhry.		
		Embankment, 7,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Thomas O'Malley, Baton Rouge, La	24¾	20	$1,896.25
2	Treinen & Bauman, Dorceyville, La	16.94	16.94	1,304.38
3	Israel R. Bobbitt, Belair, La	12¾	12¾	991.37
5	Geo. Kilkenny, Baton Rouge, La	11.25	11.25	866.25
7	C. D. Leeper, Hester, La	11.99	11	921.25
8	Michael Hanick, Plaquemine, La	11		
9	James M. Sullivan, Baton Rouge, La	11.72	10	899.00
10	Mike Tansy, Smoke Bend, La	*10.92	10	839.00
11	Donovan & Daley, Whitecastle, La	15	15	1,155.00
12	J. A. Carson, Concession, La	12	13	926.00

No.	Name and address of bidder.	St. Delphine, enlargement.		
		Embankment, 18,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Thomas O'Malley, Baton Rouge, La	24¾	20	$4,495.00
2	Treinen & Bauman, Dorcyville, La	18.90	18.90	3,439.80
3	Israel R. Bobbitt, Belair, La	15¾	15	2,797.50
5	Geo. Kilkenny, Baton Rouge, La	16	16	2,912.00
7	C. D. Leeper, Hester, La	18	18	3,276.00
9	James M. Sullivan, Baton Rouge, La	*14.90	*10	2,702.00
11	Donovan & Daley, Whitecastle, La	23.70	20	4,306.00
12	J. A. Carson, Concession, La	15.90	14	2,906.20

No.	Name and address of bidder.	Eliza, enlargement.		
		Embankment, 16,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Thomas O'Malley, Baton Rouge, La	24¾	20	$4,000.00
3	Israel R. Bobbitt, Belair, La	16	15	2,590.00
9	James M. Sullivan, Baton Rouge, La	*16	* 8	2,576.00
12	J. A. Carson, Concession, La	16¼	14	2,628.00

Amount available	$31,404.99
Amount covered by this abstract	7,361.00
Balance	24,043.99

UNITED STATES ENGINEER OFFICE,
New Orleans, La., January 14, 1895.

No. 19 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 4, 1895, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[The bids marked thus * have been accepted. They are the lowest ones received, and are considered reasonable. Copies of the letters of acceptance have been filed with the bids.]

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Violet.		
		Embankment, 6,800 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	F. C. Meyers, Pointe a la Hache, La	15	15	$1,050.00
2	Robert McNamara, New Orleans, La	18	18	1,260.00
3	Israel R. Bobbitt, Belair, La	13.74	12	958.32
4	John Cleary, New Orleans, La	*13	*13	910.00

No.	Name and address of bidder.	Linwood, enlargement.		
		Embankment, 2,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	F. C. Meyers, Pointe a la Hache, La	17	17	$274.00
2	Robert McNamara, New Orleans, La	18	18	396.00
3	Israel R. Bobbitt, Belair, La	14.74	12	318.80
4	John Cleary, New Orleans, La	*14	*14	308.00
5	Barbour & Ruple, Concession, La	14.95	14.95	328.90

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Kearney Upper.		
		Embankment, 13,800 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Robert McNamara, New Orleans, La	22	22	$3,080.00
3	Israel R. Bobbitt, Belair, La	*13½	*12	1,938.75
4	John Cleary, New Orleans, La	14	14	1,900.00
5	Barbour & Ruple, Concession, La	15.40	15.40	2,156.00

	Lake Borgne levee district.	Barataria levee district.
Amount available	$13,603.72	$18,756.34
Amount covered by this abstract	1,218.00	1,938.75
Balance	12,385.72	16,817.59

UNITED STATES ENGINEER OFFICE,
New Orleans, La., January 21, 1895.

No. 20 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 9, 1895, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[The bids marked thus * have been accepted. They are the lowest ones received and are considered reasonable. Copies of the letters of acceptance have been filed with the bids.]

ATCHAFALAYA LEVEE DISTRICT.

No.	Name and address of bidder.	Golden Ridge, new and enlargement.		
		Embankment, 19,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Michael Hanick, Plaquemine, La	9.98	9	$1,964.10
3	Hayes Bros., Baton Rouge, La	12	10	2,360.00
6	Barbour & Ruple, Concession, La	15	15	2,955.00
7	J. A. Carson, Concession, La	14	14	2,758.00
8	Tansey & Kilkenny, Baton Rouge, La	13	13	2,561.00
9	Geo. Byrne & Co., Baton Rouge, La	8.70	8.70	1,713.90
10	Donovan & Daley, Baton Rouge, La	9.70	9.70	1,910.90
11	C. D. Leeper & Co., Hester, La	12.96	9	2,545.20
12	Treinen & Bauman, Dorcyville, La	9.70	9.70	1,910.90
13	Curtis & Andrews, Bayou Goula, La	9¼	9	1,870.50
15	Manning & Gibson, Hohen Solms, La	12	12	2,364.00
16	Alvah Epley, Plaquemine, La	*8.38	*8.38	1,650.86

No.	Name and address of bidder.	Eimer Lower, enlargement.		
		Embankment, 10,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Michael Hanick, Plaquemine, La	13	13	$1,391.00
3	Hayes Bros., Baton Rouge, La	11.98	11	1,279.90
6	Barbour & Ruple, Concession, La	14.25	14.25	1,524.75
7	J. A. Carson, Concession, La	14	14	1,498.00
8	Tansey & Kilkenny, Baton Rouge, La	18	10	1,910.00
12	Treinen & Bauman, Dorcyville, La	11.74	11.74	1,256.18
13	Curtis & Andrews, Bayou Goula, La	*10.74	*9	1,145.70
15	Manning & Gibson, Hohen Solms, La	14	14	1,498.00
16	Alvah Epley, Plaquemine, La	15.99	15.99	1,710.93

No.	Name and address of bidder.	Cora, enlargement.		
		Embankment, 22,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Michael Hanick, Plaquemine, La	16	16	$3,552.00
3	Hayes Bros., Baton Rouge, La	*12	*12	2,664.00
7	J. A. Carson, Concession, La	16	16	3,552.00
13	Curtis & Andrews, Bayou Goula, La	14	11	3,102.00
15	Manning & Gibson, Hohen Solms, La	15	15	3,330.00

No. 20 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 9, 1895, etc.*—Continued.

PONTCHARTRAIN LEVEE DISTRICT.

No.	Name and address of bidder.	St. Marys Chapel, new and enlargement.		
		Embankment, 28,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
3	Hayes Bros., Baton Rouge, La	9.98	9.98	$2,814.36
4	P. J. Tyrrell, New Orleans, La	16		
7	J. A. Carson, Concession, La	13.44	13	3,789.20
8	Tansey & Kilkenny, Baton Louge, La	9.89	10	2,789.20
10	Donovan & Daley, Baton Rouge, La	*8.94	8	2,519.20
11	C. D. Leeper & Co., Hester, La	9.97	4	2,799.60
13	Curtis & Andrews, Bayou Goula, La	12	10	3,380.00
15	Manning & Gibson, Hohen Solms, La	14	14	3,948.00

No.	Name and address of bidder.	Modoc, enlargement.		
		Embankment, 8,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	P. H. O'Brien, Kenner, La	10.99	10.97	$956.09
3	Hayes Bros., Baton Rouge, La	13.92	13.92	1,211.04
5	Williford & Ryan, Kenner, La	*10.44	*10.44	908.28
6	Barbour & Ruple, LaPlace, La	15	15	1,305.00
7	J. A. Carson, Concession, La	16	16	1,392.00
11	C. D. Leeper & Co., Hester, La	12.70	10	1,099.50
14	John Cleary, New Orleans, La	14	14	1,218.00
15	Manning & Gibson, Hohen Solms, La	20	20	1,740.00

	Atchafalaya levee district.	Pontchartrain levee district.
Amount available	$27,767.38	$26,000.00
Amount covered by this abstract	5,460.56	3,427.48
Balance	22,306.82	22,572.52

UNITED STATES ENGINEER OFFICE,
New Orleans, La., January 28, 1895.

No. 21 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 17, 1895, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levee revetment in the fourth district, improving Mississippi River.*

[Bid No. 3 (marked thus *) has been accepted. It is the lowest bid received and considered reasonable. A copy of the letter of acceptance is filed with the bid.]

BARATARIA LEVEE DISTRICT.

No.	Name and address of bidder.	Concession (2,087 linear feet).	
		Per foot.	Amount.
		Cents.	
1	Davis Richarme, Belair, La	68	$1,419.16
2	Quigley & Wilcoxon, New Orleans, La	75	1,565.25
3	Robert McNamara, New Orleans, La	*60	1,252.20
4	Barbour & Ruple, Concession, La	73.5	1,533.94

No. 21 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 17, 1895, etc.*—Continued.

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Linwood (740 linear feet).		Davis (1,018 linear feet).	
		Per foot.	Amount.	Per foot.	Amount.
		Cents.		*Cents.*	
1	Davis Richarme, Belair, La	70	$518	70	$712.60
2	Quigley & Wilcoxon, New Orleans, La	95	703	95	967.10
3	Robert McNamara, New Orleans, La	*60	444	*58	590.44
4	Barbour & Ruple, Concession, La	85	629	87	885.66

	Barataria levee district.	Lake Borgne levee district.
Amount available	$18,428.09	$12,477.19
Amount covered by this abstract	1,252.20	1,034.44
Balance	17,175.89	11,442.75

UNITED STATES ENGINEER OFFICE,
New Orleans, La., February 4, 1895.

No. 22 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 26, 1895, opened this day by Capt. George MoC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[The proposals marked thus * have been accepted. They are the lowest ones received and are considered reasonable. Copies of the letters of acceptance are filed with the bids. All bids received for Wildwood levee have been rejected, as they are considered too high.]

ATCHAFALAYA LEVEE DISTRICT.

No.	Name and address of bidder.	Hermitage Dike, enlargement.		
		Embankment, 9,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Eltringham Construction Co., Natchez, Miss	39.43	18	$2,584.70
4	John A. Carson, Concession, La	32.99	32.99	3,035.08
5	Geo. Y. Andrews, Raceland, La	37	30	3,390.00
6	J. J. Gray, Baton Rouge, La	*22.42	10	2,037.80
8	James R. Marlow, Natchez, Miss	35	35	3,220.00
11	Williford & Ryan, Kenner, La	29.94	35	2,764.60
13	Israel R. Bobbitt, Wallace, La	25	20	2,290.00
15	C. D. Leeper, Hester, La	29	10	2,630.00
16	George Kilkenny, Baton Rouge, La	22½	15	2,055.00

No.	Name and address of bidder.	Wildwood, enlargement.		
		Embankment, 37,500 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Eltringham Construction Co., Natchez, Miss	29.98	18	$11,278.50
4	John A. Carson, Concession, La	35	35	13,195.00
5	Geo. Y. Andrews, Raceland, La	41½	26	15,614.50
8	James R. Marlow, Natchez, Miss	37	37	13,949.00
13	Israel R. Bobbitt, Wallace, La	32½	20	12,227.50
15	C. D. Leeper, Hester, La	33	12	12,399.00
16	George Kilkenny, Baton Rouge, La	35	20	13,165.00

No. 22 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated January 26, 1895, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

No.	Name and address of bidder.	Robertson, new and enlargement.		
		Embankment, 12,200 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
1	Michael Hanick, Plaquemine, La	15	15	$1,860.00
2	Eltringham Construction Co., Natchez, Miss	21.23	18	2,626.00
4	John A. Carson, Concession, La	14	14	1,736.00
5	George Y. Andrews, Raceland, La	10.90	8	1,345.00
6	J. J. Gray, Baton Rouge, La	12	10	1,484.00
7	Mike Tansey, Baton Rouge, La	*9.89	9	1,224.58
8	James R. Marlow, Natchez, Miss	13¾	13¾	1,705.00
10	Treinen & Bauman, Dorceyville, La	13.90	13.90	1,723.60
12	J. Curtis, Bayou Goula, La	14	14	1,736.00
14	George Byrne & Co., Baton Rouge, La	15½	15½	1,922.00
15	C. D. Leeper, Hester, La	11¼	11	1,394.50

LAKE BORGNE LEVEE DISTRICT.

No.	Name and address of bidder.	Fort St. Philip, enlargement.		
		Embankment, 5,000 cubic yards.	Excavations, 200 cubic yards.	Total cost of levee.
		Cents.	*Cents.*	
2	Eltringham Construction Co., Natchez, Miss	24.73	8.93	$1,254.36
3	F. C. Meyers, Pointe a la Hache, La	28	.....	.....
9	Robert McNamara, New Orleans, La	*18	*18	936.00

	Atchafalaya levee district.	Lake Borgne levee district.
Amount available	$21,153.27	$11,033.81
Amount covered by this abstract	3,262.38	936.00
Balance	17,890.89	10,097.81

UNITED STATES ENGINEER OFFICE,
New Orleans, La., February 19, 1895.

No. 23 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated February 8, 1895, opened this day by Capt. George McC. Derby, Corps of Engineers, for the construction of levees in the fourth district, improving Mississippi River.*

[The proposals marked thus * have been accepted. They are the lowest ones received, and are considered reasonable. Copies of the letters of acceptance are filed with the bids. All bids received for Joly Levee have been rejected on account of lack of funds.]

ATCHAFALAYA LEVEE DISTRICT.

No.	Name and address of bidder.	Cinclare Upper, enlargement.		Cinclare Lower, enlargement.	
		Embankment and excavations, 21,200 cubic yards.	Total cost of levee.	Embankment and excavations, 20,500 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	McLaughlin Bros., Natchez, Miss	9.99	$2,117.88	9.99	$2,047.95
3	Mike Tansey, Baton Rouge, La	10.20	2,162.40	11.40	2,337.00
4	Israel R. Bobbitt, Concession, La	14⅛	3,047.50	14.45	2,962.25
5	Jno. Scott & Son, Robson, La	12.87	2,728.44	13.87	2,843.35
7	Eltringham Construction Co., Natchez, Miss	12.23	2,592.76	12.23	2,507.15
8	C. D. Leeper & Co., Baton Rouge, La	12	2,544.00	14¼	2,972.50
9	Edwin B. Helgason, Natchez, Miss	10	2,120.00	*9.95	2,039.75
10	Marlow & Cary, Natchez, Miss	*9	1,908.00		
11	George Y. Andrews, Plaquemine, La	13.23	2,804.76	13.23	2,712.15
12	J. A. Andrews & Son, Baton Rouge, La	13	2,756.00	13	2,665.00
13	M. Hanick, Plaquemine, La	13	2,756.00	12	2,460.00
14	Geo. Kilkenny, Baton Rouge, La	13	2,756.00	14¼	2,972.50
15	Jos. Curtis, Bayou Goula, La	9.99	2,117.88	10¼	2,152.50

No. 23 (1895).—*Abstract of proposals received in response to advertisement (circular letter) dated February 8, 1895, etc.*—Continued.

ATCHAFALAYA LEVEE DISTRICT—Continued.

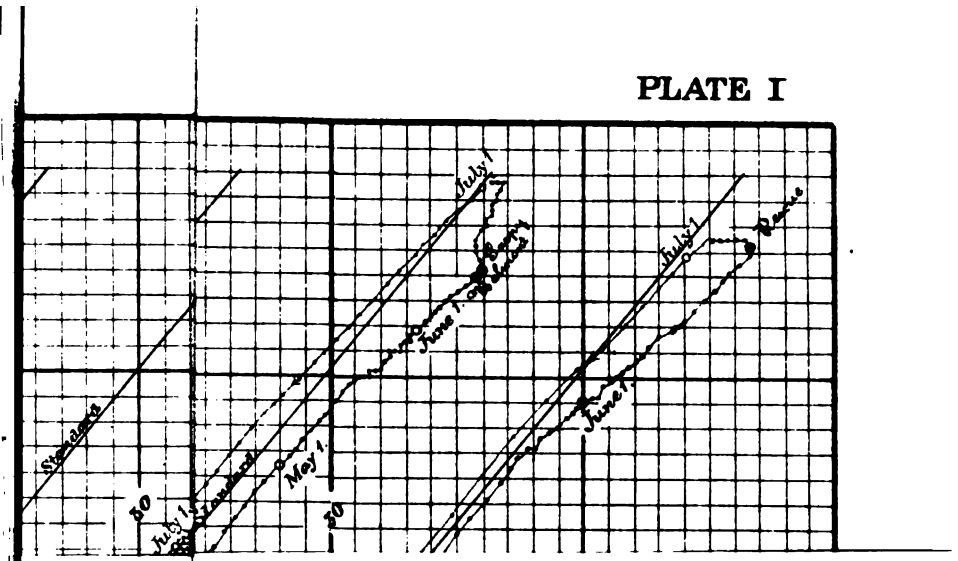
No.	Name and address of bidder.	Cohn.		Brusley Upper, enlargement.		Brusley Lower, enlargement.	
		Embankment and excavations 27,600 cubic yards.	Total cost of levee.	Embankment and excavations, 22,250 cubic yards.	Total cost of levee.	Embankment and excavations, 22,650 cubic yards.	Total cost of levee.
		Cents.		*Cents.*		*Cents.*	
1	McLaughlin Bros., Natchez, Miss.	*9⅝	$2,656.50	15	$3,337.50	*9.90	$2,242.35
3	Mike Tansey, Baton Rouge, La...	15	4,140.00	14	3,115.00	.....	.....
4	Israel R. Bobbitt, Concession, La.	13⅜	3,691.50	15.74	3,502.15	13	2,944.50
5	Jno. Scott & Son, Robson, La.....	16½	4,554.00	16.87	3,753.58	16	3,624.00
6	Donovan & Daley, Baton Rouge, La.....	11.70	3,229.20	.....	.....	18.87	4,274.06
7	Eltringham Construction Co., Natchez, Miss	13.90	3,836.40	13.90	3,092.75	.....	.....
8	C. D. Leeper & Co., Baton Rouge, La.....	13½	3,726.00	.....	.....	13.45	3,046.43
9	Edwin B. Helgason, Natchez, Miss.	11	3,036.00	14	3,115.00	12.45	2,819.93
11	Geo. Y. Andrews, Plaquemine, La.	10.74	2,964.24	*13.69	3,046.03	12	2,718.00
12	J. A. Andrews & Son, Baton Rouge, La.....	12	3,312.00	15	3,337.50	12.95	2,933.18
13	M. Hanick, Plaquemine, La.....	14	3,864.00	14	3,115.00	15	3,397.50
14	Geo. Kilkenny, Baton Rouge, La.	18	4,968.00	.....	.....	15	3,397.50
15	Jos. Curtis, Bayou Goula, La.....	17	4,692.00	14	3,115.00	11¾	2,661.38

PONTCHARTRAIN LEVEE DISTRICT.

No.	Name and address of bidder.	Joly, new and enlargement.		Golden Grove, enlargement.	
		Embankment and excavations, 28,600 cubic yards.	Total cost of levee.	Embankment and excavations, 30,300 cubic yards.	Total cost of levee.
		Cents.		*Cents.*	
1	McLaughlin Bros., Natchez, Miss.....	13⅛	$3,861.00	18	$5,454.00
2	Geo. Byrne, Baton Rouge, La.....	9⅛	2,645.50	.....	.....
4	Israel R. Bobbitt, Concession, La.....	11⅞	3,396.25	14.90	4,514.70
6	Donovan & Daley, Baton Rouge, La.....	9.70	2,774.20	11.40	3,454.20
7	Eltringham Construction Co., Natchez, Miss.....	11.23	3,211.70	13.90	4,211.70
8	C. D. Leeper & Co., Baton Rouge, La.....	11.97	3,423.42	*10.45	3,166.35
9	Edwin B. Helgason, Natchez, Miss.....	13	3,718.00	18	5,454.00
12	J. A. Andrews & Son, Baton Rouge, La.....	12	3,432.00	12	3,636.00
15	Jos. Curtis, Bayou Goula, La.....	13	3,718.00	.....	.....

	Atchafalaya levee district.	Pontchartrain levee district.
Amount available.....	$17,743.23	$18,000.00
Amount covered by this abstract.....	11,892.63	3,166.35
Balance.....	5,850.60	14,833.65

PLATE I



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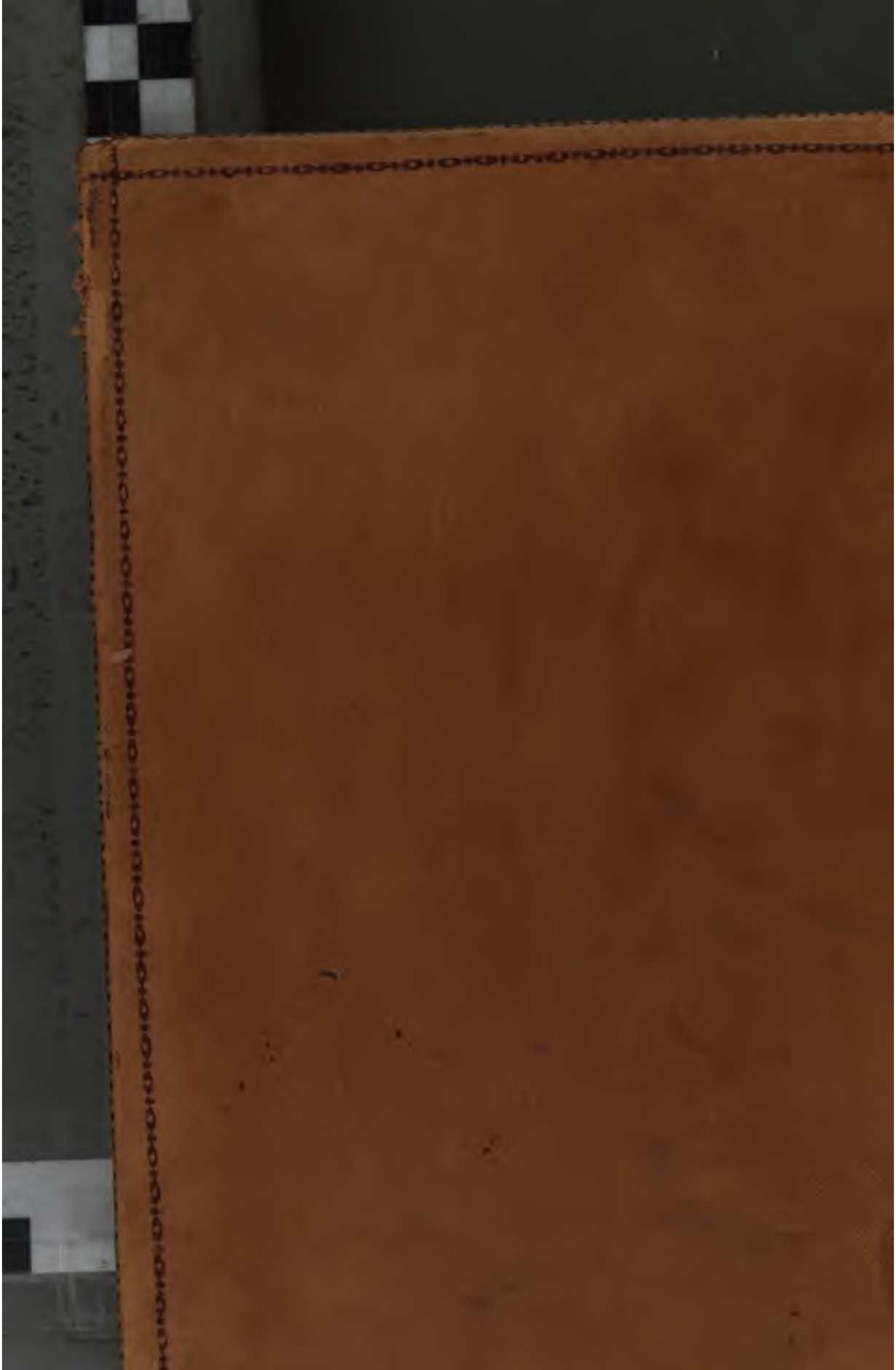
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